Solar Collector Manufacturing Activity 1984

Energy Information Administration
Office of Coal, Nuclear,
Electric and Alternate Fuels
U.S. Department of Energy
Washington, DC 20585

DOE/EIA-0174(84)
Distribution Category UC-98

Published:
August 1985

This report was prepared by the Energy Information Administration, the independent statistical and analytical agency within the Department of Energy. The information contained herein should not be construed as advocating or necessarily reflecting any policy position of the Department of Energy or any other organization.

Checking the power output of a photovoltaic concentrator array.

Contacts

This report was prepared by Science Applications International Corporation (SAIC) under contract to the Energy Information Administration, U.S. Department of Energy. Questions concerning the contents of this report should be directed to Mr. John F. Carlin, Nuclear and Alternate Fuels Division, Energy Information Administration, (202) 252-9775.

Preface

The annual Solar Collector Manufacturing Activity report presents producer shipments and end-use data from manufacturers of solar thermal collectors and photovoltaic modules. It provides annual data necessary for the Department of Energy to execute its responsibility for (1) monitoring activities and trends in the solar collector manufacturing industry, and (2) providing information on the size and status of the industry to interested groups. These groups include the Solar Energy Research Institute, solar energy specialists, manufacturers, and government agencies.

Mount Rushmore National Monument, South Dakota, showing solar collector panels (upper right) mounted on the roof of the visitors center.

BLANK PAGE

Contents

Page

1. Introduction 1

2. Solar Thermal Collector Manufacturing 3
   - Industry Status 3
   - Total Producer Shipments 3
   - Shipments by Company Headquarters Location 7
   - Shipments by Collector Type 9
   - Shipments by End Use 13
   - Shipments to Market Sectors 16
   - Imports 16
   - Exports 16
   - Related Activities 16
   - Prototype Development 16

3. Photovoltaic Module Manufacturing 21
   - Shipments by End Use 22
   - Shipments to Market Sectors 22
   - Exports 25

Appendices
- A. Form EIA-63: "Annual Solar Thermal Collector and Photovoltaic Module Manufacturers Survey" 27
- B. History and Methodology of the Survey 39
- C. Manufacturers and Importers of Solar Thermal Collectors Responding to the Survey 45
- D. Manufacturers of Photovoltaic Modules Responding to the Survey 57

Glossary 61

Tables
1. Summary of Solar Thermal Collector Shipments, Including Imports and Exports, 1974-1984 4
2. Reported and Estimated Shipments of Solar Thermal Collectors by Collector Type 1974-1984 5
3. Average Annual Manufacturer Shipments of Solar Thermal Collectors by Collector Type 1980-1984 6
4. Annual Shipments and Market Shares of the Ten Largest Manufacturers of Solar Thermal Collectors 1982-1984 7
5. Annual Shipments of Solar Thermal Collectors by Location of Company Headquarters 1982-1984 8
6. Ranking of the Top Five States by Headquarters of Companies Shipping Solar Thermal Collectors in 1984 by Type of Collector 9
7. Annual Shipments of Solar Thermal Collectors by Company Headquarters Location and Collector Type 1982-1984 10
8. Annual Shipments of Low-Temperature Solar Thermal Collectors by Manufacturer Size 1982-1984 11
9. Annual Shipments of Medium-Temperature Solar Thermal Collectors by Manufacturer Size 1982-1984 12

BEST COPY AVAILABLE

Contents

Page

Tables (continued)

10. Shipments of Solar Thermal Collectors by Type and End Use 1982-1984 14
11. Shipments of Solar Thermal Collectors by Type and Market Sector 1982-1984 17
12. Imports and Exports of Solar Thermal Collectors 1982-1984 18
13. Activities Related to Solar Thermal Collector Manufacturing Engaged in by Manufacturing Companies 1982-1984 19
14. Solar Thermal Collector Prototype Development Activities Engaged in by Manufacturing Companies 1982-1984 20
15. Photovoltaic Module Manufacturing Activity by End Use 1982-1984 21
16. Photovoltaic Module Manufacturing Activity by Market Sector 1982-1984 24

Figures

1. Solar Thermal Collector Shipments by End Use and by Market Sector 1984 15
2. Photovoltaic Module Shipments by End Use and by Market Sector 1984 .. 23
3. Photovoltaic Module Manufacturing Activity 1980-1984 26

BEST COPY AVAILABLE

1. Introduction

Solar thermal collector manufacturing data presented in this report provide summary information for the 11-year period from 1974 through 1984, and detailed information for the 3-year period from 1982 through 1984. The data were collected on Form EIA-63, "Annual Solar Thermal Collector and Photovoltaic Module Manufacturers Survey." (See Appendix A for a copy of the survey form.) For the 1984 survey, a major effort was undertaken to improve the frame, resulting in the identification of 71 manufacturers of solar thermal collectors that were not included in previous surveys. Also, in contrast to earlier surveys, no estimates were required for nonrespondents in the 1984 survey, since 100 percent of the firms surveyed responded. Because the above effort was more extensive than those of earlier surveys, the amount of total shipments of solar thermal collectors may have been understated in the earlier surveys. Therefore, the figures for total solar thermal collector shipments from the 1984 survey are not directly comparable with the figures for total shipments from earlier years (see Appendix B).

As in the past, shipments of manufactured solar collectors were reported in square feet, and the data are presented here in units of thousand square feet. All references to shipment sizes in this report refer to the amount (area) of collectors shipped, except for shipments of photovoltaic modules, which are expressed in peak watts. Appendices C and D present listings of the solar thermal collector and photovoltaic module manufacturers, respectively, that responded to the 1984 survey and granted permission for their names and addresses to appear in the report.

BEST COPY AVAILABLE

The 42 rows of concentrating solar collectors located on top of a parking ramp are part of a high-temperature solar energy system designed to provide over 50 percent of the space heat, over 80 percent of the cooling, and all of the hot water for an eight-story office building in Minneapolis, Minnesota.

2. Solar Thermal Collector Manufacturing

Industry Status

A vigorous effort to improve the survey frame of solar collector manufacturers, importers, and exporters in 1984 resulted in the addition of 71 active manufacturers of solar thermal collectors to the 1984 survey. This compares with 4 companies added to the 1983 survey frame. The expansion of the survey frame in 1984 makes it difficult to compare figures for collector shipments and industry trends. Therefore, any attempt to compare the industry status in different years should be made with caution, due to the differences in the frames. Further details of the 1984 frame development effort and a breakdown of the contributions of the 71 new firms in the survey to the total shipments reported in the 1984 survey are provided in Appendix B.

The available data suggest that the industry is currently in a phase of consolidation. In 1983, from a mailing list of 254 companies considered as probable manufacturers of solar collectors, 203 were found to be active manufacturers, 30 were out of scope, and 21 did not respond or would not release their shipment data. All of those firms were contacted again in 1984. Only 158 (62 percent) of the 254 potential manufacturers included in the 1983 survey frame were active during 1984. The other 96 companies reported no activity in solar collector manufacturing during the year, presumably because they had gone out of the solar business or had been absorbed by or merged with other companies.

Total Producer Shipments

In 1984, manufacturers shipped a total of 16.42 million square feet of solar thermal collectors of all types (Table 1). These collectors were shipped by 224 manufacturers. (Five manufacturers reported production but no shipments in 1984.) The total volumes of imports and exports of solar collectors during 1984 were 621,000 square feet and 348,000 square feet, respectively. The 1984 reporting year proved to be the highest on record for imports of solar thermal collectors.

In Table 2, the total shipments of solar thermal collectors are subdivided into two categories:

- Low-temperature collectors -- provide low-grade heat through either metallic or nonmetallic absorbers, for applications such as swimming pool heaters and low-grade water and space heating

- Medium-temperature, special, and other collectors -- provide mid- to high-grade heat, either through glazed flat-plate collectors using air or liquid heat transfer media or through concentrator collectors that concentrate the heat to levels greater than "one sun" (these include evacuated-tube collectors).

Shipments of collectors for applications in thermosyphon systems are not identified separately and are reported primarily as medium-temperature liquid-type collectors.

In 1984, total shipments of low-temperature and medium-temperature collectors were 4.5 million square feet and 11.9 million square feet, respectively. The average annual shipment per manufacturer was 73.3 thousand square feet of collectors (Table 3). The average annual shipments of low-temperature and medium-temperature collectors by manufacturers in 1984 were 93.3 thousand square feet and 58.0 thousand square feet, respectively.

BEST COPY AVAILABLE

Table 1. Summary of Solar Thermal Collector Shipments, Including Imports and Exports, 1974-1984

Year	Number of Manufacturers Reporting Shipments	Number of Nonrespondents	Collector Shipments (thousand square feet) Total Shipments	Imports	Exports
1984	224	0	16,419	621	348
1983	203	21	16,828[a]	511	159
1982	265	9	18,621[a]	418	455
1981	203	79	20,133[a]	196	771
1980	233	43	19,398[a]	235	1,115
1979	349	0	14,251	290	855
1978	340	0	10,860	396	840
1977	321	0	10,312	NA	NA
1976	186	0	5,801	NA	NA
1975	131	0	3,743	NA	NA
1974	45	0	1,274	NA	NA

[a]Includes imputation for nonrespondents.

NA = data not available.

Source: Solar Collector Manufacturing Activity Survey, 1974-1984 (Form EIA-63, 1978-1984; telephone survey by the Federal Energy Administration, 1974-1977).

BEST COPY AVAILABLE

Table 2. Reported and Estimated Shipments of Solar Thermal Collectors by Collector Type 1974-1984

Year	Data Source	Low-Temperature		Medium-Temperature[a]	
		Thousand Square Feet Shipped	Percent Estimated	Thousand Square Feet Shipped	Percent Estimated
1984	Reported	4,479	0	11,939	0
1983	Reported	3,526		11,678	
	Estimated	1,327		297	
	Total	4,853	27	11,975	2
1982	Reported	7,370		11,002	
	Estimated	106		143	
	Total	7,476	1	11,145	1
1981	Reported	8,339		10,023	
	Estimated	338		1,433	
	Total	8,677	4	11,456	13
1980	Reported	11,299		6,468	
	Estimated	934		697	
	Total	12,233	8	7,165	10
1979	Reported	8,395	0	5,857	0
1978	Reported	5,872	0	4,988	0
1977	Reported	4,743	0	5,569	0
1976	Reported	3,876	0	1,925	0
1975	Reported	3,026	0	717	0
1974	Reported	1,137	0	137	0

[a]Includes medium-temperature, special (concentrator and evacuated-tube), and other solar thermal collector types.

Source: Solar Collector Manufacturing Activity Survey, 1974-1984 (Form EIA-63, 1978-1984; telephone survey by the Federal Energy Administration, 1974-1977).

Table 3. Average Annual Manufacturer Shipments of Solar Thermal Collectors by Collector Type 1980-1984

Year	Collector Type	Number of Manufacturers	Average Annual Shipments Per Manufacturer (thousand square feet)
1984	Low-temperature	48	93.3
	Medium-temperature[a]	206	58.0
	All collector types	224	73.3
1983	Low-temperature	55	88.2
	Medium-temperature[a]	179	66.9
	All collector types	224	75.1
1982	Low-temperature	61	122.6
	Medium-temperature[a]	248	44.9
	All collector types	274	68.0
1981	Low-temperature	75	115.7
	Medium-temperature[a]	263	43.6
	All collector types	282	71.4
1980	Low-temperature	79	154.8
	Medium-temperature[a]	250	28.7
	All collector types	276	70.3

[a]Includes medium-temperature, special, and other solar thermal collector types.

Source: Form EIA-63 (1983-84, "Annual Solar Thermal Collector and Photovoltaic Module Manufacturers Survey"; 1980-82, "Solar Collector Manufacturers and Importers Survey").

BEST COPY AVAILABLE

Of the 16.4 million square feet of thermal collectors shipped in 1984, 7.9 million square feet (48.3 percent) were manufactured by the ten largest companies in terms of shipments (Table 4). The five largest companies were responsible for approximately one-third of all shipments of solar thermal collectors.

Shipments by Company Headquarters Location

Table 5 provides a breakdown of solar collector shipments according to the States in which the company headquarters are located. Small solar collector manufacturing firms generally locate their headquarters and manufacturing facilities in the same State; thus, data on shipments by headquarters State for those firms would accurately reflect shipments by State of production facility. For three important groups of companies, however, this is not necessarily true:

- Conglomerates. A conglomerate that reports on production by its subsidiary would report such production according to the location of the parent company, which may or may not be in the same State where the collectors are produced.
- Large or National Manufacturers. Very large or nationwide solar collector manufacturing companies may have several production facilities at different locations around the country. In all but two cases, company shipments are reported according to the location of the company headquarters.
- Importers. Companies that import solar collectors report shipments to consumers according to the location of the company; however, these firms may or may not be engaged in manufacturing.

Table 4. Annual Shipments and Market Shares of the Ten Largest Manufacturers of Solar Thermal Collectors 1982-1984

Year	Company Rank	Thousand Square Feet of Solar Thermal Collectors Shipped	Percent of Industry Total[a]
1984	1-5	5,320	32.4
	6-10	2,605	15.9
	1-10	7,925	48.3
1983	1-5	5,919	35.2
	6-10	2,752	16.4
	1-10	8,671	51.5
1982	1-5	6,320	33.9
	6-10	2,560	13.7
	1-10	8,880	47.7

[a]Totals may not equal sum of components due to independent rounding.

Source: Form EIA-63, "Annual Solar Thermal Collector and Photovoltaic Module Manufacturers Survey."

Table 5. Annual Shipments of Solar Thermal Collectors by Location of Company Headquarters 1982-1984

Company Headquarters Location[b]	Thousand Square Feet Shipped[a] 1984	1983[c]	1982[c]
Alabama	183	130	223
Arizona	767	890	858
California	5,725	6,579	6,076
Colorado	818	718	1,019
Connecticut	200	W	35
Florida	3,093	2,886	3,876
Georgia	W	25	27
Hawaii	104	19	26
Illinois	17	82	32
Indiana	39	W	W
Iowa	208	93	57
Maine	45	W	W
Massachusetts	49	W	163
Michigan	480	W	65
Minnesota	35	W	302
New Hampshire	38	W	27
New Jersey	640	691	1,139
New Mexico	340	W	583
New York	1,454	1,968	1,670
North Carolina	50	W	250
Ohio	680	252	104
Oregon	92	65	83
Pennsylvania	94	W	174
South Carolina	W	W	20
Tennessee	W	155	365
Texas	476	W	421
Virginia	368	W	383
Wisconsin	9	W	28
U.S. Total[d]	16,419	16,828	18,621

[a]Amounts shown here may not equal sum of components shown in Table 7, due to independent rounding.

[b]May not be the site of the manufacturing facility.

[c]Includes adjusted data for nonrespondents.

[d]Totals include shipments for States in which information was withheld to avoid disclosure of individual company data.

W = Withheld to avoid disclosure of individual company data.

Source: Form EIA-63, "Annual Solar Thermal Collector and Photovoltaic Module Manufacturers Survey."

Shipments by Collector Type

Table 6 ranks the five States for which manufacturers of the largest volumes of solar collector shipments were reported in 1984, subdivided according to type of collector. Companies with headquarters located in California led in shipments of both low-temperature collectors and medium-temperature collectors (including special and other collector types). However, the ranking of the other States differed for the two categories.

Table 7 provides a breakdown of the annual shipments of low-temperature and medium-temperature collectors according to the States in which the company headquarters are located. The five largest manufacturers of low-temperature solar collectors (in terms of the annual total of square feet shipped) accounted for a little more than 86 percent of all shipments of low-temperature collectors in 1984 (Table 8). The 12 largest manufacturers of medium-temperature, special, and "other" collectors (in terms of annual square feet shipped) accounted for 48.5 percent of all shipments of those collector types (Table 9).

Table 6. Ranking of the Top Five States by Headquarters of Companies Shipping Solar Thermal Collectors in 1984 by Type of Collector

	States in Which Company Headquarters Are Located	
Ranking	Shipments of Low-Temperature Collectors	Shipments of Medium-Temperature Collectors[a]
1	California	California
2	New York	Florida
3	Florida	Colorado
4	New Jersey	Arizona
5	New Mexico	Ohio

[a]Includes medium-temperature, special, and other thermal collector types.

Source: Form EIA-63, "Annual Solar Thermal Collector and Photovoltaic Module Manufacturers Survey."

Table 7. Annual Shipments of Solar Thermal Collectors by Company Headquarters Location and Collector Type 1982-1984
(Thousand Square Feet)

Company Headquarters Location[b]	Shipments of Low-Temperature Collectors			Shipments of Medium-Temperature Collectors[a]		
	1984	1983[c]	1982[c]	1984	1983[c]	1982[c]
Alabama	W	0	200	W	130	24
Arizona	20	15	151	747	875	707
California	1,798	3,071	3,196	3,927	3,508	2,880
Colorado	9	W	0	809	W	1,019
Connecticut	2	W	0	198	27	35
Florida	811	96	1,802	2,282	2,790	2,074
Georgia	0	14	0	W	11	27
Hawaii	0	0	0	104	19	26
Illinois	W	78	15	W	5	17
Indiana	0	W	W	39	W	W
Iowa	24	24	0	184	69	57
Maine	0	W	W	45	W	W
Massachusetts	0	0	0	49	W	163
Michigan	3	0	0	476	W	64
Minnesota	W	W	180	W	41	122
New Hampshire	W	0	0	W	W	27
New Jersey	550	536	696	90	155	443
New Mexico	71	W	264	269	237	319
New York	1,132	891	810	323	1,077	861
North Carolina	0	0	0	50	W	250
Ohio	13	7	5	667	245	99
Oregon	W	0	0	W	65	83
Pennsylvania	0	W	1	94	123	173
South Carolina	0	W	0	W	16	20
Tennessee	0	11	33	W	144	332
Texas	5	W	18	471	594	403
Virginia	30	W	11	337	389	372
Wisconsin	0	0	0	9	W	28
U.S. Total[d]	4,479	4,853	7,476	11,939	11,975	11,145

[a]Includes medium-temperature, special, and other thermal collector types.
[b]May not be the site of the manufacturing facility.
[c]Includes adjusted data for nonrespondents.
[d]Totals include shipments for States in which information was withheld to avoid disclosure of individual company data.
W = Withheld to avoid disclosure of individual company data.
Source: Form EIA-63, "Annual Solar Thermal Collector and Photovoltaic Module Manufacturers Survey."

BEST COPY AVAILABLE

Table 8. Annual Shipments of Low-Temperature Solar Thermal Collectors by Manufacturer Size 1982-1984

Year	Manufacturer Size (thousand square feet shipped)	Number of Manufacturers	Annual Shipments (thousand square feet)	Percent of Total Annual Shipments
1984	200 or more	5	3,854	86.1
	100 to 199	1	150	3.3
	50 to 99	3	212	4.7
	10 to 49	7	178	4.0
	2 to 9	17	76	1.7
	1 to 1.9	5	6	<1.0
	0.9 or less	10	3	<1.0
	Total	48	4,479[a]	100.0[a]
1983[b]	200 or more	5	4,100	84.5
	100 to 199	1	114	2.3
	50 to 99	5	364	7.5
	10 to 49	9	194	4.0
	2 to 9	14	64	1.3
	1 to 1.9	9	13	<1.0
	0.9 or less	12	4	<1.0
	Total	55	4,853[a]	100.0[a]
1982[b]	200 or more	8	6,197	R82.9
	100 to 199	5	809	10.8
	50 to 99	2	164	2.2
	10 to 49	12	235	3.1
	2 to 9	14	58	R0.8
	1 to 1.9	6	8	<1.0
	0.9 or less	14	6	<1.0
	Total	61	7,476[a]	100.0[a]

[a]Totals may not equal sum of components due to independent rounding.
[b]Includes adjusted data for nonrespondents.
R = revised data.
Source: Form EIA-63, "Annual Solar Thermal Collector and Photovoltaic Module Manufacturers Survey."

BEST COPY AVAILABLE

Table 9. Annual Shipments of Medium-Temperature Solar Thermal Collectors by Manufacturer Size 1982-1984

Year	Manufacturer Size (thousand square feet shipped)	Number of Manufacturers	Annual Shipments (thousand square feet)	Percent of Total Annual Shipments
1984	200 or more	12	5,786	48.5
	100 to 199	24	3,144	26.3
	50 to 99	19	1,318	11.0
	10 to 49	54	1,372	11.5
	2 to 9	54	288	2.4
	1 to 1.9	13	16	<1.0
	0.9 or less	30	15	<1.0
	Total	206	11,939[a]	100.0[a]
1983[b]	200 or more	17	7,884	R65.8
	100 to 199	13	1,740	14.5
	50 to 99	13	924	7.7
	10 to 49	48	1,182	9.9
	2 to 9	48	217	1.8
	1 to 1.9	14	19	<1.0
	0.9 or less	26	10	<1.0
	Total	179	11,975[a]	100.0[a]
1982[b]	200 or more	15	5,648	R50.7
	100 to 199	19	2,499	R22.4
	50 to 99	14	1,028	9.2
	10 to 49	65	1,544	R13.9
	2 to 9	72	376	3.4
	1 to 1.9	25	33	<1.0
	0.9 or less	38	16	<1.0
	Total	248	11,145[a]	100.0[a]

[a]Totals may not equal sum of components due to independent rounding.
[b]Includes adjusted data for nonrespondents.
R = revised data.
Source: Form EIA-63, "Annual Solar Thermal Collector and Photovoltaic Module Manufacturers Survey."

Shipments by End Use

During 1984, 54.4 percent of all collectors shipped were reported for use in domestic hot water heating, 27.0 percent for pool heating, 14.4 percent for space heating, and 2.8 percent were for industrial processing (Table 10 and Figure 1). Approximately 1.4 percent of the total shipped during 1984 was for "other" uses (including combination systems and educational applications), and less than 0.1 percent was for space cooling. During the 1984 reporting period, no manufacturers reported shipments of collectors for use in agricultural processing.

Solar thermal collectors shipped during 1983 were divided among the end-use categories as follows: 55.4 percent for domestic hot water heating, 29 percent for pool heating, 12 percent for space heating, and 1 percent for industrial processing. Thus, the major market shares of collector end-use categories were virtually unchanged from 1983 to 1984. The corresponding figures for 1982 were 40 percent for domestic hot water heating, 38 percent for pool heating, 13 percent for space heating, and 1.6 percent for industrial processing.

More than 83 percent of the low-temperature solar collectors shipped during 1984 were made for use in pool heating; 93 percent of these were nonmetallic collectors. In comparison, 92 percent of the low-temperature collectors shipped during 1983 were for pool heating, and 93 percent of those were nonmetallic collectors. In 1982, 87 percent were used for pool heating, of which 95 percent were nonmetallic collectors. During 1984, 5.1 percent of the low-temperature solar collectors shipped were for use in space heating, compared with 3.3 percent and 9.5 percent in 1983 and 1982, respectively.

Domestic hot water heating is the primary end use for medium-temperature solar collectors. Approximately 72 percent of the medium-temperature collectors shipped during 1984 were reported for this purpose, and around 96 percent of them were liquid collectors. More than 18 percent of the medium-temperature collectors shipped during 1984 were applied to space heating; 65 percent of these were air-type collectors. Approximately 2 percent of the medium-temperature collectors shipped in 1984 were for industrial processing applications, and approximately 84 percent of these were liquid collectors (Table 10).

Medium-temperature collectors shipped during 1983 were also intended primarily for domestic hot water heating (76 percent); 98 percent of these were liquid collectors. Space heating applications accounted for 17 percent, of which 72 percent were liquid collectors. The corresponding figures for 1982 were 65 percent for domestic hot water heating, 99 percent being liquid-type collectors, and 15 percent for space heating, of which 67 percent were liquid collectors.

The primary end uses for special concentrator and evacuated-tube collectors shipped during 1984 were domestic hot water heating (81 percent) and space heating (12 percent). In comparison, 84 percent of the special collectors shipped in 1983 were for hot water heating, and 9 percent were for industrial processing. In 1982, 66 percent were for hot water heating and 13 percent for industrial processing.

BEST COPY AVAILABLE

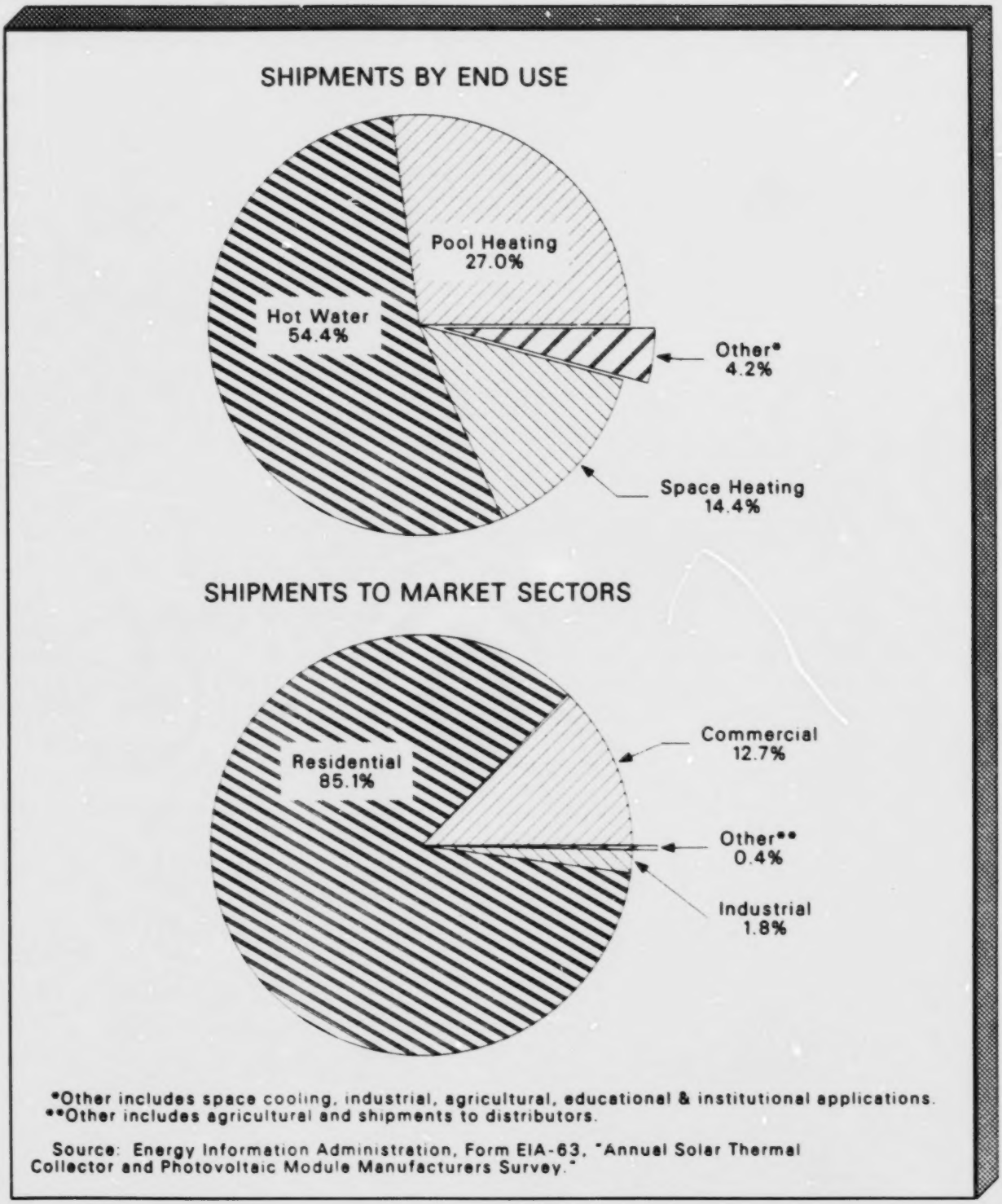
Table 10. Shipments of Solar Thermal Collectors by Type and End Use 1982-1984
(Thousand Square Feet Shipped Annually)

Year and Collector Type	End Use: Pool Heating	Hot Water	Space Heating	Space Cooling	Industrial Processing	Agricultural Processing	Other[a]	Total[b]
1984								
Low-Temperature								
Nonmetallic	3,447	227	200	0	226	0	0	4,100
Metallic	278	71	28	0	3	0	0	380
Medium-Temperature								
Air	2	324	1,369	1	35	0	155	1,885
Liquid	699	8,050	742	11	189	0	51	9,743
Special								
Concentrator	1	149	0	0	4	0	14	168
Evacuated-Tube	0	66	31	0	0	0	0	98
Other	0	44	[c]	0	0	0	3	46
Total[b]	4,427	8,930	2,370	12	457	0	223	16,419
1983[d]								
Low-Temperature								
Nonmetallic	4,158	104	73	0	1	0	0	R4,337
Metallic	327	105	85	0	0	0	0	517
Medium-Temperature								
Air	[c]	132	529	0	0	83	30	774
Liquid	352	8,448	1,379	5	127	23	250	10,584
Special								
Concentrator	[c]	374	7	8	46	0	0	435
Evacuated-Tube	[c]	57	8	13	0	0	0	78
Other	[c]	103	0	0	0	0	0	104
Total[b]	4,839	9,323	2,082	25	174	106	279	16,828
1982[d]								
Low-Temperature								
Nonmetallic	6,211	90	315	0	0	53	1	6,669
Metallic	314	79	398	0	0	16	1	807
Medium-Temperature								
Air	1	83	535	1	0	22	492	1,134
Liquid	473	6,773	1,073	20	210	16	792	9,357
Special								
Concentrator	34	383	20	31	85	[c]	[c]	552
Evacuated-Tube	2	36	24	21	[c]	0	[c]	84
Other	[c]	[c]	1	0	0	0	15	17
Total[b]	7,035	7,444	2,367	73	295	107	1,301	18,621

[a]Includes educational and institutional applications.
[b]Totals may not equal sum of components due to independent rounding.
[c]Less than 500 square feet.
[d]Includes adjusted data for nonrespondents.
Source: Form EIA-63, "Annual Solar Thermal Collector and Photovoltaic Module Manufacturers Survey."

BEST COPY AVAILABLE

Figure 1. Solar Thermal Collector Shipments by End Use and by Market Sector 1984



*Other includes space cooling, industrial, agricultural, educational & institutional applications.
**Other includes agricultural and shipments to distributors.

Source: Energy Information Administration, Form EIA-63, "Annual Solar Thermal Collector and Photovoltaic Module Manufacturers Survey."

BEST COPY AVAILABLE

Shipments to Market Sectors

The residential market sector received shipments of 13.98 million square feet of solar thermal collectors in 1984, or 85.1 percent of the total amount shipped during the year (Table 11 and Figure 1).

The share of shipments to the commercial sector continued to decline in 1984. Shipments to this sector during the current year represented only 12.7 percent of all shipments of solar thermal collectors, compared with 18.1 percent in 1983 and 20.3 percent in 1982.

The share of shipments to the industrial sector declined to 1.8 percent of the total in 1984. The share of shipments to the agricultural and "other" market sectors also showed dramatic declines, from 2.9 percent of total shipments in 1982 and 2.0 percent in 1983 to only 0.4 percent in 1984.

Imports

Imports of solar thermal collectors in 1984 totaled 0.62 million square feet (Table 12). Eight U.S. companies imported solar thermal collectors during 1984, receiving imports from Australia, Israel, and the United Kingdom.

Exports

During 1984, the total amount of exports of solar thermal collectors was 0.35 million square feet. Solar thermal collectors were exported to the following countries: Austria, Belize, British Virgin Islands, Canada, Chile, Colombia, Dubai, Egypt, Ecuador, France, Greece, Guatemala, Honduras, India, Iraq, Israel, Jamaica, Lebanon, Nigeria, Panama, Puerto Rico, Saudi Arabia, South Africa, South Korea, Sweden, Taiwan, and Turkey.

Related Activities

The 224 companies shipping solar collectors in 1984 also reported being engaged in one or more of the following activities: 186 in wholesale distribution; 135 in retail distribution; 130 in systems design and consulting; 115 in installation; 95 in component manufacturing; and 103 in prototype development (Table 13).

Prototype Development

During 1984, 103 companies reported prototype development activities. The total number of prototype development activities reported for 1984 was 184. (A firm may have projects in more than one category and more than one project in a given category. The survey did not seek to identify individual development projects.) Of the 184 activities reported in 1984, 107 (58 percent) were in the area of medium-temperature collectors, 30 (16 percent) in low-temperature collectors, 24 (13 percent) in the "other" category, and 23 (13 percent) in the area of special collectors (Table 14).

BEST COPY AVAILABLE

Table 11. Shipments of Solar Thermal Collectors by Type and Market Sector 1982-1984

(Thousand Square Feet Shipped Annually)

Year and Collector Type	Market Sector					
	Residential	Commercial	Industrial	Agricultural	Other[a]	Total[b]
1984						
Low-Temperature						
Nonmetallic	3,407	602	57	34	0	4,100
Metallic	312	64	3	0	(c)	380
Medium-Temperature						
Air	1,743	122	17	2	1	1,885
Liquid	8,240	1,272	211	17	3	9,743
Special						
Concentrator	157	8	1	0	2	168
Evacuated-Tube	76	22	0	0	0	98
Other	45	1	0	0	0	46
Total[b]	13,980	2,091	289	53	6	16,419
1983[d]						
Low-Temperature						
Nonmetallic	3,791	527	10	9	0	4,337
Metallic	392	118	6	1	0	517
Medium-Temperature						
Air	671	18	1	84	0	774
Liquid	6,422	2,313	1,600	2	247	10,584
Special						
Concentrator	377	10	48	0	0	435
Evacuated-Tube	34	44	0	0	0	78
Other	94	10	0	0	0	104
Total[b]	11,780	3,039	1,665	97	247	16,828
1982[d]						
Low-Temperature						
Nonmetallic	5,084	1,506	9	61	9	6,669
Metallic	609	150	16	32	(c)	807
Medium-Temperature						
Air	907	195	(c)	22	9	1,134
Liquid	6,710	1,808	450	46	344	9,357
Special						
Concentrator	389	79	85	0	(c)	552
Evacuated-Tube	29	51	(c)	0	4	84
Other	1	0	0	0	15	17
Total[b]	13,729	3,789	560	161	381	18,621

[a]Includes shipments to distributors.
[b]Totals may not equal sum of components due to independent rounding.
[c]Less than 500 square feet.
[d]Includes adjusted data for nonrespondents.
Source: Form EIA-63, "Annual Solar Thermal Collector and Photovoltaic Module Manufacturers Survey."

BEST COPY AVAILABLE

Table 12. Imports and Exports of Solar Thermal Collectors 1982-1984

Year	Collector Type	Number of Companies	Total Annual Imports or Exports (thousand square feet)	Percent of Total Annual Imports or Exports
Imports				
1984		8	621	100
1983		7	511	100
1982		7	418	100
Exports				
1984	Low-Temperature	4	230	66
	Medium-Temperature[a]	21	118	34
	Total	25	348	100
1983	Low-Temperature	W	W	W
	Medium-Temperature[a]	W	W	W
	Total	23	159	100
1982	Low-Temperature	6	318	70
	Medium-Temperature[a]	29	137	30
	Total	35	455	100

[a]Includes medium-temperature, special, and other collector types.
W = Value withheld to avoid disclosure of individual company data.
Source: Form EIA-63, "Annual Solar Thermal Collector and Photovoltaic Module Manufacturers Survey."

BEST COPY AVAILABLE

Table 13. Activities Related to Solar Thermal Collector Manufacturing Engaged in by Manufacturing Companies 1982-1984

Type of Activity	Number of Manufacturers Engaged in Activity		
	1984	1983	1982
Distribution			
Wholesale	186	176	220
Retail	135	135	160
System Design and Consulting	130	130	177
Installation	115	104	135
Manufacturing of Components	95	90	107
Prototype Development	103	168	212

Source: Form EIA-63, "Annual Solar Thermal Collector and Photovoltaic Module Manufacturers Survey."

BEST COPY AVAILABLE

Table 14. Solar Thermal Collector Prototype Development Activities Engaged in by Manufacturing Companies 1982-1984

Collector Type Being Developed	Number of Activities Engaged in by Manufacturers[a]		
	1984[b]	1983[c]	1982[d]
Low-Temperature			
Nonmetallic	5	18	21
Metallic	25	38	38
Medium-Temperature			
Air	47	45	58
Liquid	60	101	131
Special			
Concentrator	12	16	21
Evacuated-Tube	11	6	8
Other	24	27	38

[a]Manufacturers engaged in more than one activity may be counted more than once.

[b]A total of 103 companies reported prototype development activities during 1984.

[c]A total of 168 companies reported prototype development activities during 1983.

[d]A total of 212 companies reported prototype development activities during 1982.

Source: Form EIA-63, "Annual Solar Thermal Collector and Photovoltaic Module Manufacturers Survey."

BEST COPY AVAILABLE

3. Photovoltaic Module Manufacturing

During 1984, 23 companies reported the manufacture and sale of photovoltaic modules capable of producing a total of 9,912 peak kilowatts. This represents a decrease of 21 percent from the 1983 figure of 12,620 peak kilowatts, but it is 44 percent higher than the 1982 figure of 6,897 peak kilowatts (Table 15).

This section contains several changes in content and in data from those published in the past. The most important changes are as follows:

- Revised 1983 data. The 1983 data in the tables showing distribution of photovoltaic modules by end use and by market sector have been revised. The changes are due primarily to the addition of a new category (government) and to the redefinition and redistribution of utility applications from the "commercial" to the "other" category. In the process of this reclassification, key manufacturers were contacted, and some additional changes were made beyond those affecting these two categories. However, the total shipment data for 1983 did not change.

Table 15. Photovoltaic Module Manufacturing Activity by End Use 1982-1984

	Annual Shipments by Manufacturers					
	1984[a]		1983[b]		1982[c]	
End Use	Amount Shipped (peak kilowatts)	Percent of Total	Amount Shipped (peak kilowatts)	Percent of Total	Amount Shipped (peak kilowatts)	Percent of Total
Specialty	470	4.7	R242	R1.9	88	1.3
Stand-Alone	3,475	35.1	R3,334	R26.4	3,265	47.3
Residential	492	5.0	R160	R1.3	51	0.7
Intermediate	204	2.1	R93	R0.7	454	6.6
Central Power ...	5,271	53.2	R8,791	R69.6	3,040	44.1
Total[d]	9,912	100.0	12,620	100.0	6,897	100.0

[a]A total of 23 companies reported photovoltaic module manufacturing activity during 1984.

[b]A total of 18 companies reported photovoltaic module manufacturing activity during 1983.

[c]A total of 19 companies reported photovoltaic module manufacturing activity during 1982.

[d]Totals may not equal sum of components due to independent rounding.

R = Revised data.

Source: Form EIA-63, "Annual Solar Thermal Collector and Photovoltaic Module Manufacturers Survey."

BEST COPY AVAILABLE

- Addition of a new table. Table 15, detailing photovoltaic module manufacturing activity by end use, did not appear in previous reports. The data in this table were previously published in text format and also presented in a graph. In this report, a table listing quantities in peak watts and percentages is used to augment the text and figure.

In addition to the above changes, historical data on shipments of photovoltaic modules are presented in a revised table format, and a figure has been added to depict the data visually.

The list of potential manufacturers of photovoltaic modules was expanded from 31 firms in 1983 to 45 firms in 1984. Only 6 of the 14 new firms were found to be active, however, representing only 0.7 percent of the total 1984 shipments (for further details, see Appendix B).

Shipments by End Use

Photovoltaics manufactured in 1984 were shipped primarily for use in central power applications (53.2 percent) and stand-alone systems (35.1 percent). Intermediate (utility-connected) applications accounted for about 2 percent, specialty uses almost 5 percent, and residential (utility-connected) uses the remaining 5 percent (Table 15 and Figure 2). End-use activities in 1984 generally continue the end-use profile of industry shipments in 1983. As shown in Table 15, end-use activities for photovoltaic modules in 1983 were dominated by central power applications (69.6 percent), with stand-alone applications being the second most common end use (26.4 percent). Over the past 3 years, stand-alone applications have expanded steadily, from 3.265 million peak watts in 1982 to 3.334 million peak watts in 1983 and 3.475 million peak watts in 1984. In all 3 years, other end uses accounted for only a small fraction of total shipments, with residential and specialty end uses also showing steady growth.

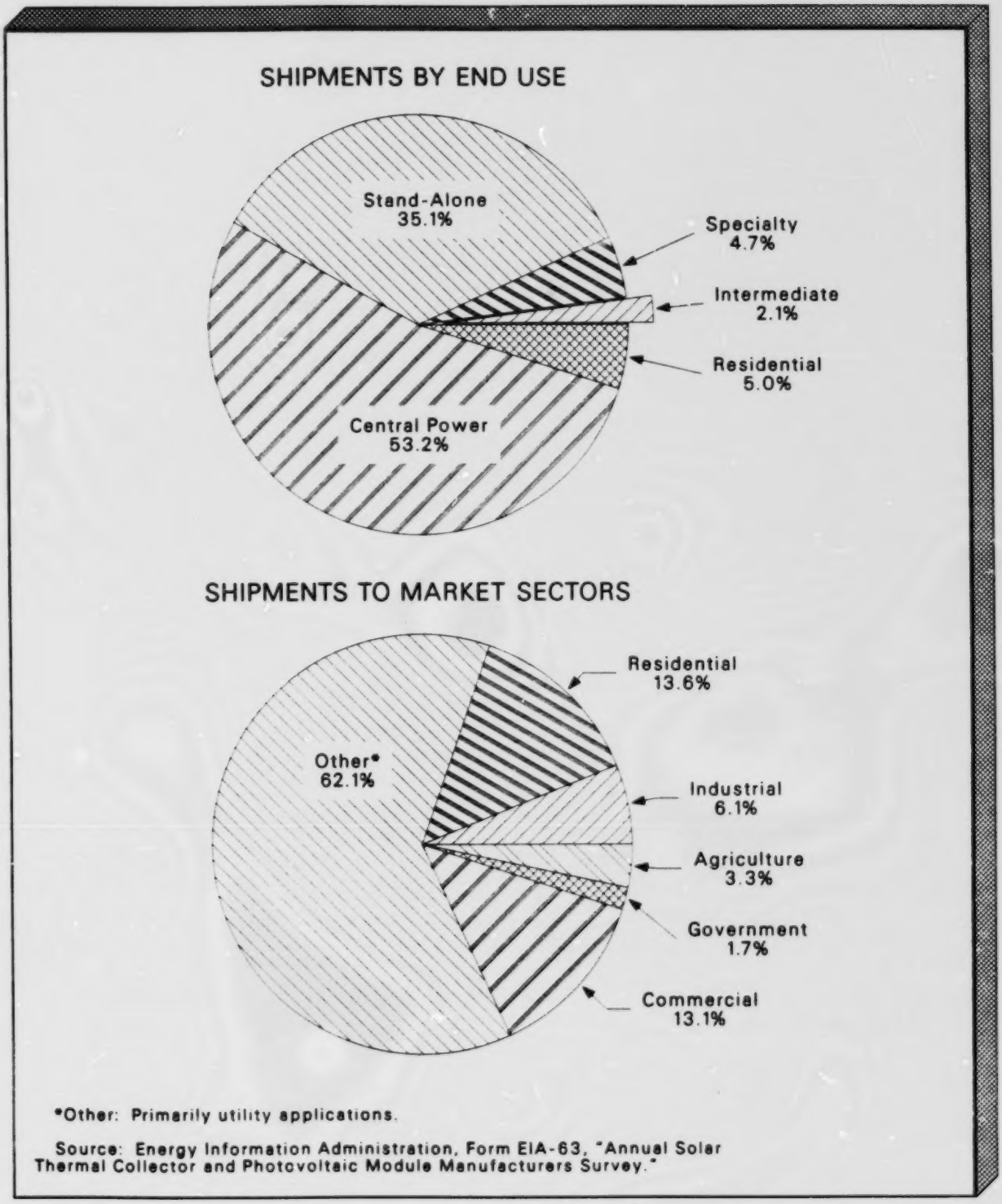
Shipments to Market Sectors

About 62 percent of all shipments of solar photovoltaic collectors in 1984 were to the "other" market sector, representing primarily utility applications (Table 16). Shipments to the remaining sectors were as follows: 13.6 percent to the residential sector, 13.1 percent to the commercial sector, 6.1 percent to the industrial sector, 3.3 percent to the agricultural sector, and 1.7 percent to the governmental sector (Figure 2).

Revised 1983 data show that shipments to the "other" sector dominated the market with 61.8 percent. The residential and industrial sectors were responsible for approximately equal shares of the market, 11.7 percent and 11.6 percent, respectively. The governmental and commercial sectors also represented essentially equal shares in 1983, with 6.2 percent and 5.6 percent, respectively. The agricultural sector had a small share of the 1983 shipments, with 3.0 percent.

BEST COPY AVAILABLE

Figure 2. Photovoltaic Module Shipments by End Use and by Market Sector 1984



*Other: Primarily utility applications.

Source: Energy Information Administration, Form EIA-63, "Annual Solar Thermal Collector and Photovoltaic Module Manufacturers Survey."

BEST COPY AVAILABLE

Table 16. Photovoltaic Module Manufacturing Activity by Market Sector 1982-1984

	Annual Shipments by Manufacturers			
	1984[a]		1983[b]	
Market Sector	Amount Shipped (peak kilowatts)	Percent of Total	Amount Shipped (peak kilowatts)	Percent of Total
Residential	1,344	13.6	R1,479	R11.7
Commercial	1,301	13.1	R710	R5.6
Industrial	608	6.1	R1,467	R11.6
Agricultural	329	3.3	R384	R3.0
Government	171	1.7	787	R6.2
Other[c]	6,160	62.1	R7,793	R61.8
Total[d]	9,912	100.0	12,620	100.0
Export	2,153	21.7	R1,903	R15.1

[a]A total of 23 companies reported photovoltaic module manufacturing activity during 1984 (including 13 companies that also reported exports).

[b]A total of 18 companies reported photovoltaic module manufacturing activity during 1983 (including 8 companies that also reported exports).

[c]Primarily utility applications.

[d]Totals may not equal sum of components due to independent rounding.

R = Revised data.

Source: Form EIA-63, "Annual Solar Thermal Collector and Photovoltaic Module Manufacturers Survey."

BEST COPY AVAILABLE

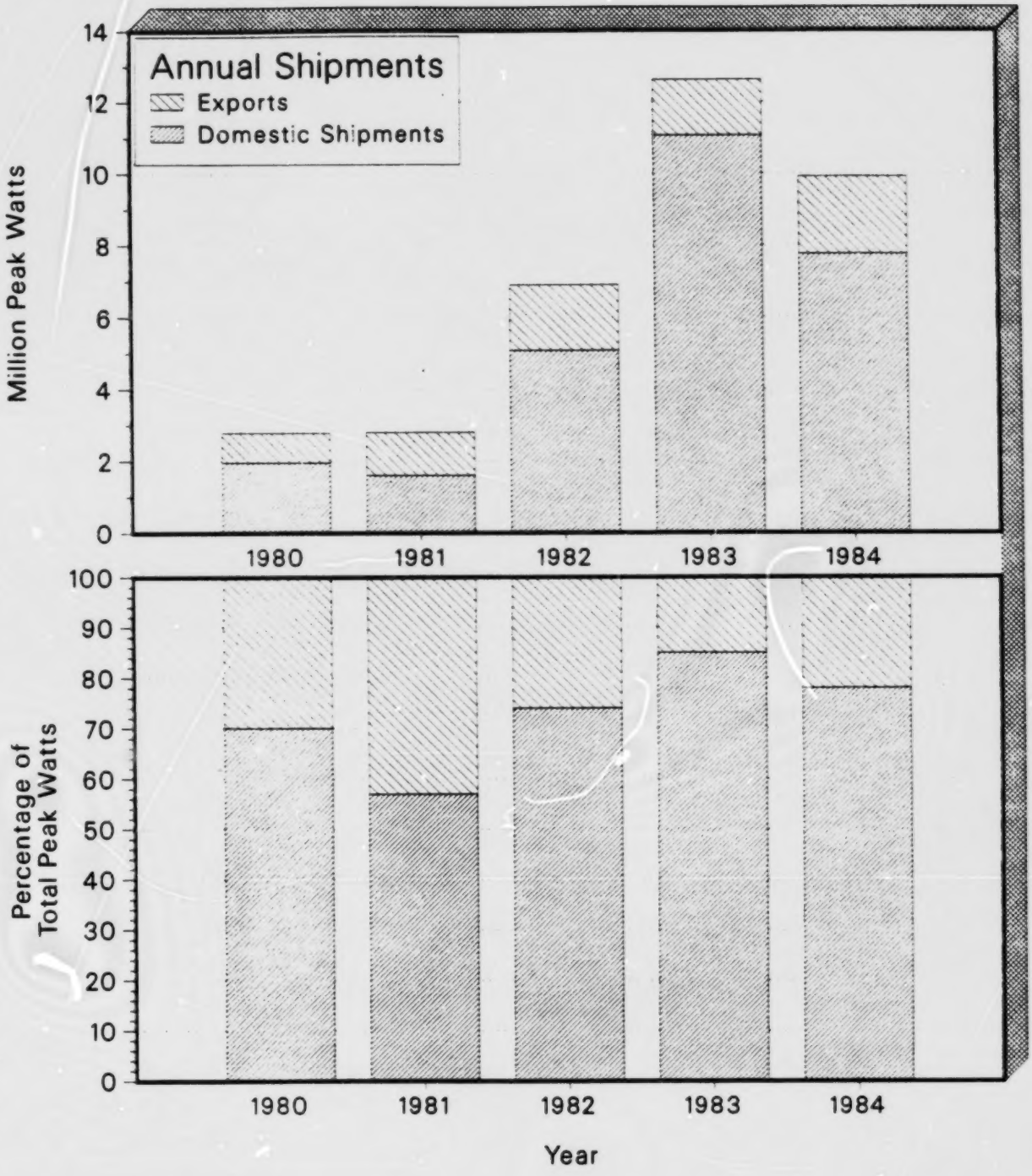
Exports

Thirteen manufacturers exported photovoltaic modules in 1984, compared with 8 in 1983. Approximately 22 percent of all photovoltaic shipments during 1984 were for export, compared with 15 percent in 1983. Figure 3 shows domestic shipments and exports of photovoltaic modules.

Exports of photovoltaic modules to 27 specific countries during 1984 were reported. The specific countries identified were Australia, Botswana, Brazil, Canada, Colombia, Ethiopia, France, Greece, Guatemala, Honduras, Hong Kong, Indonesia, Malaysia, Norway, Oman, Pakistan, Philippines, Senegal, Singapore, South Africa, Spain, Sudan, Taiwan, West Germany, United Kingdom, Yugoslavia, and Zimbabwe. In some cases, specific countries of destination were not given. For example, some manufacturers reported exports to categories such as Latin America, the Far East and Middle East, Africa, Europe, Asia, and Scandinavia. Therefore, the exact number of countries receiving shipments of U.S. photovoltaic modules during 1984 is not known.

BEST COPY AVAILABLE

Figure 3. Photovoltaic Module Manufacturing Activity 1980-84



Source: Energy Information Administration, Form EIA-63, "Annual Solar Thermal Collector and Photovoltaic Module Manufacturers Survey."

BEST COPY AVAILABLE

Appendix A

Form EIA-63: Annual Solar Thermal Collector and Photovoltaic Module Manufacturers Survey

Solar collector consisting of a 7-meter point-focus parabolic dish.

BLANK PAGE

Appendix A

Form EIA-63

U.S. DEPARTMENT OF ENERGY
Energy Information Administration

ANNUAL SOLAR THERMAL COLLECTOR AND PHOTOVOLTAIC MODULE MANUFACTURERS SURVEY

Form Approved
OMB No. 1905-0074
(Expires 6/30/85)

This report is mandatory under Public Laws 93-275 and 95-91. Late filing, failure to file, or failure otherwise to comply with these instructions may result in criminal fines, civil penalties, and other sanctions as provided by law. See instructions for information concerning confidentiality.

1.0 IDENTIFICATION DATA

1.1 Respondent Identification

Complete (a) - (d) only if label is incorrect

(a) Company Name _____

(b) Street Address _____

(c) City _____

(d) State and Zip _____

1.2 What is the name, title and telephone number of a person within your company to whom questions may be addressed regarding this submission?

(a) Name _____

(b) Title _____

(c) Telephone (☐☐☐) ☐☐☐ - ☐☐☐☐
Area Code — Number

1.3 Did your company go out of business in the past year? *If yes, please sign.*

(a) ☐ No
(b) ☐ Yes _____
Signature

1.4 Is this a new or a revised report?

(a) ☐ New — Mo ☐☐ Da ☐☐ Yr ☐☐

(b) ☐ Revised – *Enter date of resubmission*
Mo ☐☐ Da ☐☐ Yr ☐☐

2.0 MANUFACTURING STATUS

2.1 During the current reporting period, did your company...

(a) Manufacture and sell solar energy collectors? (a) ☐ Yes (b) ☐ No

(b) Manufacture, but have no reported sales of solar energy collectors? (a) ☐ Yes (b) ☐ No

(c) Import solar energy collectors? (a) ☐ Yes (b) ☐ No

(d) Export solar energy collectors? (a) ☐ Yes (b) ☐ No

NOTE: *If you answered "Yes" to any part of 2.1 above, answer questions 3.1 and 3.2 and/or 3.3 as appropriate and complete the remainder of this form.*
If you answered "No" to all of the questions in 2.1 above, complete 6.0 and return this form to the address specified in the instructions.

3.0 HISTORICAL/MARKETING DATA

3.1 SOLAR THERMAL COLLECTOR MANUFACTURERS **ONLY.** *Place an "X" in each box to indicate all the activities in which your company is engaged. (Mark all that apply.)*

(a) ☐ Wholesale Distribution
(b) ☐ Retail Distribution
(c) ☐ Systems Design/Consulting
(d) ☐ Installation
(e) ☐ Manufacturer of Component Parts for Others
(f) ☐ Prototype Development - answer 3.2
(g) ☐ None

Skip 3.2 unless (f) is also marked.

BEST COPY AVAILABLE

3.2 SOLAR THERMAL COLLECTOR MANUFACTURERS ONLY

Indicate the prototype(s) developed by your company. (Mark all that apply.)

- (a) ☐ Low Temperature Non-metallic
- (b) ☐ Low Temperature Metallic
- (c) ☐ Medium Temperature Air
- (d) ☐ Medium Temperature Liquid
- (e) ☐ Special, Concentrator
- (f) ☐ Special, Evacuated Tube
- (g) ☐ Other, Describe: _____
- (h) ☐ None

3.3 PHOTOVOLTAIC MODULE MANUFACTURERS ONLY

Indicate the areas of research and development in which your company is engaged. (Mark all that apply.)

FLAT PLATE COLLECTORS

- (a) ☐ Single Crystal Silicon
- (b) ☐ Other *(describe)* _____

CONCENTRATING COLLECTORS

- (c) ☐ Point Focus Fresnel
- (d) ☐ Line Focus Fresnel
- (e) ☐ Parabolic Trough
- (f) ☐ Other *(describe)* _____
- (g) ☐ None

4.0 PUBLICATION DATA

4.1 Do you want the name and address of your company to appear in the Appendix of the Solar Collector Manufacturing and Importing Activities Report?

- (a) ☐ Yes
- (b) ☐ No

4.2 Do you want to receive a copy of the Solar Collector Manufacturing and Importing Activities Report?

- (a) ☐ Yes
- (b) ☐ No

5.0 MANUFACTURER DATA

5.1 How many employees in your company currently do solar-related work?

- (a) ☐ Less than 10
- (b) ☐ 11 - 25
- (c) ☐ 26 - 50
- (d) ☐ More than 50

5.2 Solar-related activities comprise what percent of your company's total sales volume?

- (a) ☐ 100%
- (b) ☐ 50 - 99%
- (c) ☐ 10 - 49%
- (d) ☐ Less than 10%

5.3 Type of company

- (a) ☐ Single proprietorship
- (b) ☐ Partnership
- (c) ☐ Corporation
- (d) ☐ Other *(describe)* _____

BEST COPY AVAILABLE

6.0 CERTIFICATION		
I certify that the information contained herein and appended hereto is true and accurate to the best of my knowledge.		
Name	Date	Signature
Title		
Enter any additional remarks here:		

Title 18 USC 1001 makes it a criminal offense for any person knowingly and willingly to make to any Agency or Department of the United States any false, fictitious or fraudulent statements as to any matter within its jurisdiction.

EIA-63 (10-82)

BEST COPY AVAILABLE

Company Name: _____ Company Identification (DOE ID): _____

7.0 SOLAR THERMAL COLLECTOR DATA. *For each collector type produced or imported and sold enter the following data:*

Item	COLLECTOR TYPE							Total
	LOW TEMPERATURE		MEDIUM TEMPERATURE		SPECIAL		Other	
	Non-Metallic (a)	Metallic (b)	Air (c)	Liquid (d)	Concentrator (e)	Evacuated Tube (f)	(g)	(h)
7.1 GRAND Total Producer Shipments (Sq. ft.)								
7.2 Total Value of Shipments in 7.1 ($)								
7.3 Site-Built Collectors (Sq. ft)								
7.4 Total Value of Shipments in 7.3 ($)								
7.5 Market Sector (Sq. ft.)								
(1) Residential								
(2) Commercial								
(3) Industrial								
(4) Agriculture								
(5) Other, *describe* :								
(6) Total, Market Sector								
7.6 End Use (Sq. ft.)								
(1) Pool Heating								
(2) Hot Water								
(3) Space Heating								
(4) Space Cooling								
(5) Industrial Processing								
(6) Agricultural Processing								
(7) Other, *describe:*								
(8) Total, End Use								
7.7 Imports (Sq. ft. of total included in 7.1)								
7.8 Exports (Sq. ft. of total included in 7.1)								

7.9 Imports received from: _____

DOE USE ONLY
(a)[ ][ ] (b)[ ][ ] (c)[ ][ ] (d)[ ][ ]

7.10 Exports to: _____

DOE USE ONLY
(a)[ ][ ] (b)[ ][ ] (c)[ ][ ] (d)[ ][ ]

BEST COPY AVAILABLE

BLANK PAGE

BLANK PAGE

BLANK PAGE

BEST COPY AVAILABLE

Company Name: _____ Company Identification (DOE ID): _____

8.0 PHOTOVOLTAIC COLLECTOR DATA. *For each collector type shipped or imported and sold enter the following data:*

Item	COLLECTOR TYPE						Total
	FLAT PLATE		CONCENTRATING				
	Silicon (a)	Other (b)	Point Focus Fresnel (c)	Line Focus Fresnel (d)	Parabolic Trough (e)	Other (f)	(g)
8.1 GRAND Total Producer Shipments (WATTS)							
(1) Concentration Level							
8.2 Total Value of Shipments ($ of total in 8.1)							
8.3 Customers (WATTS)							
(1) Residential							
(2) Commercial							
(3) Agricultural							
(4) Industrial							
(5) Government							
(6) Other, *describe:*							
(7) TOTAL Customer Shipments (WATTS; should equal 8.1)							
8.4 End Use (WATTS)							
(1) Speciality							
(2) Stand Alone							
(3) Residential (Utility Connect)							
(4) Intermediate (Utility Connect)							
(5) Central Power							
(6) TOTAL End Use (WATTS; should equal 8.1)							
8.5 Imports (Amount of total WATTS included in 8.1)							
8.6 Exports (Amount of total WATTS included in 8.1)							

8.7 Imports Received From: _____

DOE USE ONLY
(a)[ ][ ] (b)[ ][ ] (c)[ ][ ] (d)[ ][ ]

8.8 Exports to: _____
_____

DOE USE ONLY
(a)[ ][ ] (b)[ ][ ] (c)[ ][ ] (d)[ ][ ]

INSTRUCTIONS FOR FORM EIA-63
ANNUAL SOLAR THERMAL COLLECTOR AND PHOTOVOLTAIC MODULE MANUFACTURERS SURVEY

GENERAL INFORMATION AND INSTRUCTIONS

I. Purpose

Form EIA-63 is designed to provide the data necessary for the Energy Information Administration (EIA) in the Department of Energy to execute its role in tracking certain volumetric movements within the solar collector manufacturing industry and in providing information concerning the size and status of the industry. The publication, "Solar Collector Manufacturing Activity," will contain results of the survey and will list solar collector manufacturers and importers.

II. Who Should Submit

Form EIA-63 is to be submitted by all companies that manufacture solar thermal collectors or photovoltaic modules and/or companies that are importers of solar energy collectors.

III. Where to Submit

Companies should return completed EIA-63 forms to:

Energy Information Administration, EI-421
Mail Station: BG-094-Forrestal
U.S. Department of Energy
ATTN: EIA-63
Washington, D.C. 20585

Requests for further information and/or additional forms may be directed to the above address or by contacting the survey project manager at 252.9775.

IV. When to Submit

Completed EIA-63 forms are due on the date specified in the covering letter. The reporting period is January 1 through December 31.

V. Sanctions

This report is mandatory and is being required pursuant to the authorities granted to DOE by the Federal Energy Administration Act of 1974 (P.L. 93-275) and the Department of Energy Organization Act (P.L. 95-91).

VI. Provisions for Confidentiality

Information on this form will not be published by the DOE in individually identifiable form. However, upon, receipt of a request for individually identifiable information, the DOE will follow the procedures listed below:

1. The information contained in this form will be kept confidential to the extent that it satisfies the criteria set forth in the Freedom of Information Act (FOIA) exemption for trade secrets and confidential commercial information and DOE regulations implementing the FOIA, and is prohibited from public release by the Trade Secrets Act, 18 U.S.C. § 1905.

   Upon receipt of a request for disclosure of this information under the FOIA, the DOE shall, in accordance with the procedures and criteria provided in 10 C.F.R. § 1004.11, make a final determination whether the information is exempt from disclosure. To assist us in this determination, respondents should demonstrate to the DOE that their information constitutes trade secrets or commercial or financial information whose release would be likely to cause substantial harm to their company's competitive position. A letter accompanying the submission that explains (on an element-by-element basis, if possible) the reasons why the information would be likely to cause the respondent substantial competitive harm if released to the public would aid in this determination. A new justification does not need to be provided each time information is submitted on the form, if the company has previously submitted a justification for that information and the justification has not changed.

BEST COPY AVAILABLE

GENERAL INFORMATION AND INSTRUCTIONS (Continued)

2. Requests from other Federal agencies for information from this form shall be evaluated in accordance with the DOE Policy on the Disclosure of Individually Identifiable Energy Information in the Possession of the EIA [45 Fed. Reg. 59812 (1980)].

3. Except as otherwise provided by law, the information will also be made available in response to an order of a Court of competent jurisdiction, or upon written request, to the Congress, any Committee of Congress, the General Accounting Office, or other Congressional agencies authorized by law to receive such information.

DEFINITIONS

1. Export – A solar collector shipment sent from the United States to another country.

2. Import – A solar collector shipment sent into the United States from another country.

3. Low Temperature Collector – A collector which generally operates in the temperature range below 110°F. Typically, it has no glazing and no insulation, and is made of plastic or rubber, although some are made of metal.

4. Medium Temperature Collector – A collector which generally operates in the temperature range of 140°F to 180°F, but it can also operate as low as 110°F. Typically, it has one or two glazings, a metal frame, a metal absorption panel with integral flow channels or attached tubing (liquid collector) or with integral ducting (air collector), and with insulation on the sides and the back.

5. Producer Shipments – Square feet of solar collectors shipped or installed in a manufacturer/importer's own facility for testing or actual use (includes exports).

6. Prototype – An original type or form that serves as a model for future collector types.

7. Solar Collector – A device designed to receive solar radiation and convert it to thermal energy. Normally, a solar collector includes a frame, glazing, and absorber together with appropriate insulation.

8. Special Collector – An evacuated tube collector or a concentrating (focusing) collector. Special collectors operate in the temperature range from just above ambient (low concentration for pool heating) to several hundred degrees Fahrenheit (high concentration for air-conditioning and specialized industrial processes).

SPECIFIC INSTRUCTIONS

If you are filing a revised report, enter only the information to be corrected and the certification information. If additional space is needed for any response, please use the Remarks Section.

Specific instructions for most items are provided below. Items which are self-explanatory are not discussed.

Item	Instruction
1.1 (a) - (d)	Make any corrections to the company name or address in the space provided.
1.2 (a) - (c)	Enter the name, title, and telephone number of an individual within the reporting company who may be contacted for additional information regarding this submission.
2.1	If your answer is "no" to all the Questions in 2.1, complete Section 6.0, "Certification," and return this form to the address listed in these instructions.

BEST COPY AVAILABLE

SPECIFIC INSTRUCTIONS (Continued)

Item	Instruction
6.0	This part must be completed each time the form is submitted. Enter the name and title of the individual designated by the company to sign the certification. This individual must sign in the space provided on the form and enter the date of signing. If your answer was "no" to all the Questions in 2.1, section 7.0 and 8.0 need not be completed.
Remarks Section:	Use this space to enter any additional comments or to clarify answers to any question on the EIA-63.
7.1	These instructions apply only to solar thermal collector manufacturers. Enter the square feet in whole numbers (i.e., no decimals) of solar collector areas shipped or installed (including exports and imports) in the appropriate collector type column. Total should be the total square feet of all collector types.
7.2	The value reported should be your company's net billing price, freight-on-board factory, including charges for cooperative advertising and warranties. Do not include excise taxes, freight, or transportation. Report value to the nearest dollar.
7.3	Enter the square feet, by collector type, of producer shipments of site-built collectors. Site-built collectors are defined as collector components that are fabricated at the installation site.
7.4	Enter the dollar value, rounded to the nearest whole dollar, of the producer shipments for site-built collectors by collector type. Total should be the total dollar value for all collector types.
7.5	For each appropriate market sector, enter the square feet of producer shipments by collector type as precisely as possible. For market sector categories in question 7.5: Part (1) Residential – solar applications related to any building used for residential occupancy which has a system for heating or cooling or both. Part (2) Commercial – solar applications for use in business where services (rather than products) are provided, such as wholesale and retail trade, and health and educational services. Part (3) Industrial – solar applications for use in businesses where products (rather than services) are provided, such as in the manufacture and processing of goods and basic materials. Part (4) Agriculture – solar applications related to food processing. Part (5) self-explanatory. Part (6) Total should be the same total square feet of all collector types as entered in 7.1.
7.6	For each end use enter the square feet of producer shipments by collector type as precisely as possible. For each end-use category in question 7.6: Part (1) self-explanatory. Part (2) self-explanatory. Part (3) If collectors are used for space heating, or space heating in combination with hot water, enter the total square feet. Part (4) If collectors are used for space cooling, or space cooling in combination with hot water and/or space heating, enter the total square feet.

BEST COPY AVAILABLE

SPECIFIC INSTRUCTIONS (Continued)

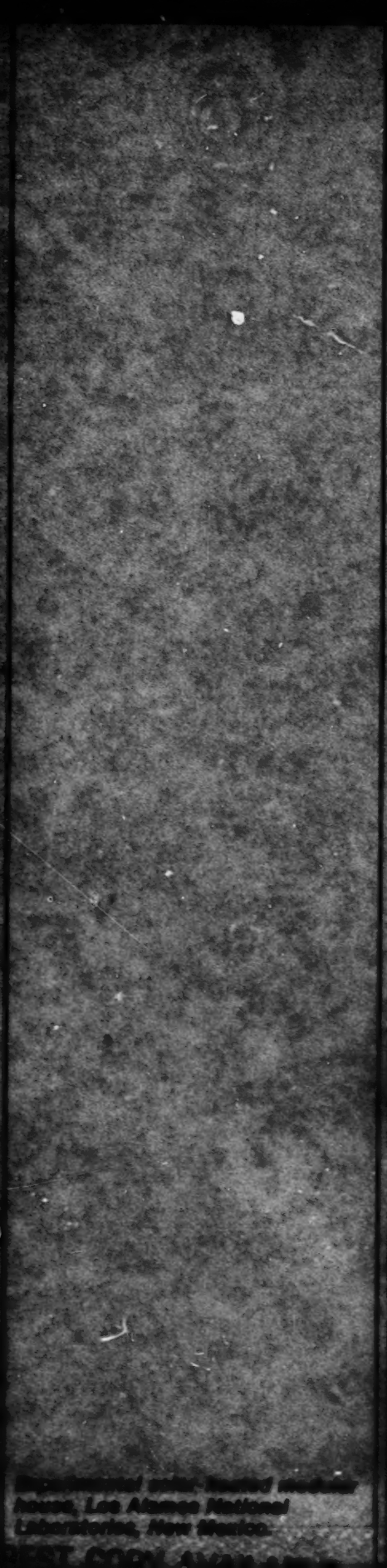
Item	Instruction
7.6 (Continued)	Part (5) self-explanatory.
	Part (6) self-explanatory.
	Part (7) self-explanatory.
	Part (8) Total should be the total square feet of all collector types entered in 7.1.
7.7	Enter the square feet by collector type. This represents the portion of total producer shipments entered in 7.1 that were imported and sold.
7.8	Enter the square feet by collector type. This represents the portion of total producer shipments entered in 7.1 that were exported and sold.
7.9	Enter the country(ies) from which solar collectors were imported.
7.10	Enter the country(ies) to which solar collectors were exported.
8.0	Instructions for this section are the same as those in Section 7.0 except that the measurement used is watts. This section applies only to photovoltaic module manufacturers.
8.1	For part (1), enter concentration level of concentrating collectors. If collectors are manufactured at more than one level, specify breakdown by levels on a separate sheet. For photovoltaic module manufacturers, collector types are defined as: Flat Plate Collectors: Single Crystal Silicon – A collector containing cells made with single crystal silicon. Concentrating Collectors: Point Focus Fresnel – A collector in which sunlight focuses on one cell. Line Focus Fresnel – A collector in which sunlight focuses on a line of cells. Parabolic Through – A type of line focus collector in which the reflected surface is parabolic in cross-section.
8.4	For photovoltaic module manufacturers, end-use categories are: Speciality – Includes uses in hand calculators, music boxes, toys, etc. Stand Alone – Uses in systems not connected to an electric grid. Residential (Utility Connected) – Any uses in a residence. Intermediate (Utility Connected) – Commercial, institutional, or industrial applications. Central Power – Use in a central electric generation facility.

BEST COPY AVAILABLE

BLANK PAGE

Appendix B

History and Methodology of the Survey



BLANK PAGE

Appendix B

History and Methodology of the Survey

History of the Survey

The Energy Information Administration (EIA) and its precursor organizations began in 1975 to conduct voluntary telephone surveys of known and probable manufacturers of solar thermal collectors. The goal of these surveys was to obtain information on manufacturing activity in the solar energy industry. The first survey covered manufacturing activities for 1974. Succeeding surveys were conducted every 6 months, to inform both public and private interests of trends in the industry. The mandatory reporting of data under Public Law 93-275 began with the survey period covering July through December 1978. Beginning in 1982, the survey was administered on an annual rather than semiannual basis.

The current report presents the findings of the third annual survey of solar collector manufacturing activity. Annual totals for the past 3 years are presented for manufacturers of both solar thermal collectors and photovoltaic modules.

Methodology of the Survey

Survey Form EIA-63 (Appendix A) was mailed to 425 companies identified as known or probable manufacturers or importers of solar thermal collectors and to 45 companies identified as known or probable manufacturers of photovoltaic modules. Potential respondents were identified from Form EIA-63 mailing lists, listings from the Solar Energy Industries Association, trade publications, State directories of solar collector manufacturers, and personal inquiries.

A vigorous effort to identify manufacturers of solar thermal collectors and photovoltaic modules was made during 1984. This effort resulted in a list of 156 potential new respondents engaged in the manufacture of solar thermal collectors and 14 potential new respondents engaged in the manufacture of photovoltaic modules. Table B1 presents the resulting status of the 156 potential new respondents in the area of solar thermal collectors. The 71 new, active manufacturers represent 32 percent of all the active manufacturers reporting shipments of solar thermal collectors in 1984, with 3.3 million square feet of collectors shipped -- more than 20 percent of the total shipments reported for 1984. The distribution of shipments by this group of manufacturers, listed according to collector type, is shown in Table B2.

Responses to the Current Survey

Manufacturers of Solar Thermal Collectors

Responses to the 1984 survey by manufacturers of solar thermal collectors are shown in Table B3. Of the 425 surveys mailed to potential manufacturers of solar thermal collectors, 229 were returned by active manufacturers (5 of these manufactured collectors during 1984 but did not ship any), 55 were out-of-scope companies, 130 were out of business, and 11 were duplicates. Out-of-scope companies are

BEST COPY AVAILABLE

Table B1. Status of the 156 Potential New Manufacturers of Solar Thermal Collectors in the 1984 Survey

Status	Number of Companies
Active	71
Out of Scope	7
Out of Business	78
No Response	0
Total	156

Table B2. Solar Thermal Collector Manufacturing Activity During 1984 by the 71 New, Active Manufacturers Identified in the 1984 Survey, by Collector Type

Collector Type	Annual Shipments (thousand square feet)
Low-Temperature	
Nonmetallic	151.6
Metallic	72.8
Total	224.4
Medium-Temperature	
Air	943.8
Liquid	2,149.5
Total	3,093.3
Special	
Concentrator	1.0
Evacuated-Tube	2.0
Total	3.0
Other	0.3
Total	3,321.0

BEST COPY AVAILABLE

Table B3. Status of Solar Thermal Collector Manufacturers in the 1984 Survey

Status	Number of Companies
Active	229[a]
Out of Scope	55
Out of Business	130
No Response	0
Duplicate	11
Total	425

[a]Five of these companies reported manufacturing activity but no sales in 1984.

those reporting no manufacturing activity during the survey period. Companies were identified as being out of business when their survey forms were returned as undeliverable by the U.S. Postal Service, and when their last known telephone numbers were disconnected, and no new numbers were available.

The data presented in this document are based on the actual data reported by the 224 companies reporting shipments of solar collectors during the reporting year. Because there were no nonrespondents, no estimation procedures were needed. The total number of active manufacturers for which data were available during the current survey period (224) is up from that for the 1983 survey period (203).

Manufacturers of Photovoltaic Modules

Responses to the current survey by manufacturers of photovoltaic modules are shown in Table B4. Although the mailing list was expanded from 31 firms in 1983 to 45 in 1984, only 6 of the 14 new firms were active during the year; 4 were out of scope, and 4 were out of business. The 6 new firms that were active during the year did not account for a significant amount of the total production of photovoltaic modules. These firms accounted for only 65,820 peak watts (0.7 percent of the total produced in 1984), of which 6,150 peak watts were exported (0.3 percent of the total 1984 exports).

The data presented in Tables 15 and 16 in the text are based on the actual data received from 23 companies that reported shipments of photovoltaic modules during the survey period. These 23 companies do not include companies reporting manufacturing activity but no shipments during 1984. No estimation procedures were required, since there were no nonrespondents.

BEST COPY AVAILABLE

Table B4. Status of Photovoltaic Module Manufacturers in the 1984 Survey

Status	Number of Companies
Active	23
Out of Scope	10
Out of Business	12
No Response	0
Total	45

General Procedures

Form EIA-63 is an annual survey form covering the 12-month period from January through December of each calendar year (see Appendix A for a copy of the survey form). The surveys are mailed once a year, in late December. Survey questions are designed to elicit data on company size, manufacturing, importing, exporting, and related activities.

Care has been taken to establish the survey frame accurately. However, as the solar collector manufacturing industry is subject to sporadic entry and exit of manufacturers, it is possible that the frame for this survey might exclude some of the newer manufacturers.

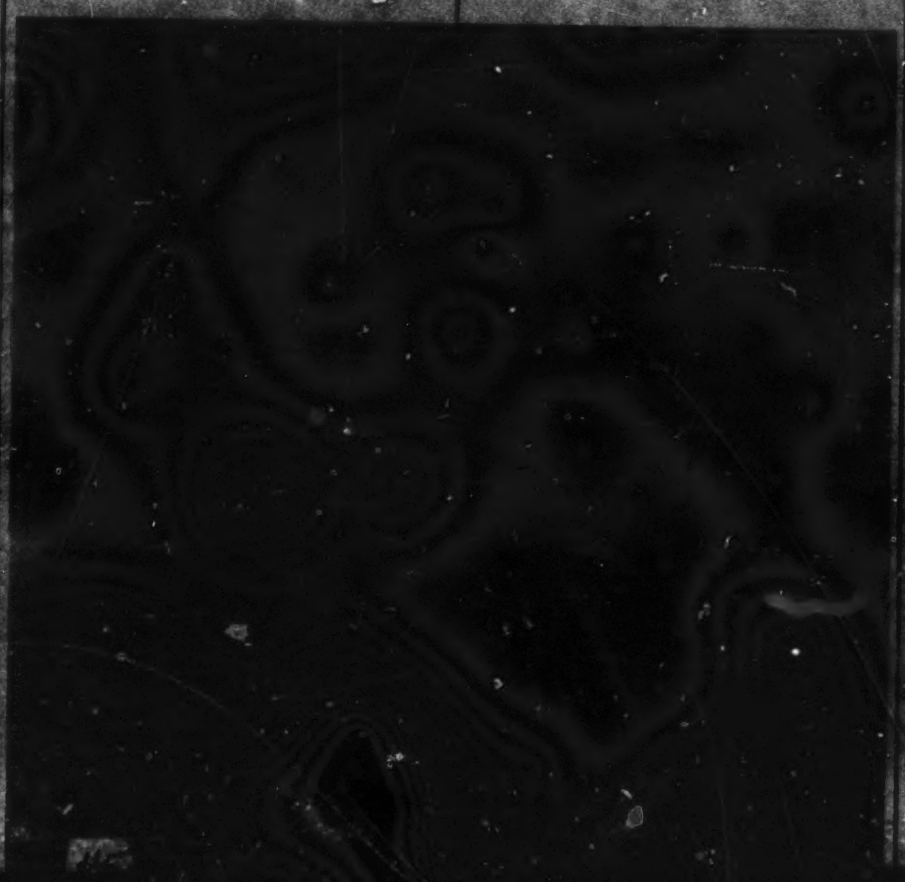
Manufacturers of solar thermal collectors were requested to indicate the area (in square feet) of collectors manufactured, describe prototype development, note other activities in which they were engaged, and provide information concerning market sector and end-use breakdowns, as well as company size and structure. All appropriate data were disaggregated by type of solar collector. Manufacturers of photovoltaic modules were asked to provide similar data indicating production capacity in peak watts.

Responses to the survey were first edited manually to verify the accuracy of the reporting and to ensure reliability of the data. Individual company responses were then compared with the data reported in previous surveys. Wherever manual editing procedures indicated discrepancies or omissions, error resolution calls were made by telephone to confirm and/or clarify the data. Data from the manually edited forms were then entered onto disk and edited a second time, via an automated procedure, to check for errors. Follow-up procedures were carried out to reduce the nonresponse rate and resulting bias. Follow-up procedures consisted of (1) reminder calls to all companies that did not return completed survey forms within 2 to 3 weeks of the mailout date and (2) a second round of calls to companies that did not respond within the 1-month period specified in the cover letter. During the second round of calls, data were taken over the phone whenever possible. Data taken by telephone were entered on blank forms, which were then returned to the companies for verification and signature.

BEST COPY AVAILABLE

Appendix C

Manufacturers and Importers of Solar Thermal Collectors Responding to the Survey



Worker assembling nonimaging solar concentrators capable of gathering sunlight scattered by haze, smog, and air pollution, as well as direct sunlight.

BLANK PAGE

Appendix C

Manufacturers and Importers of Solar Thermal Collectors Responding to the Survey

ACORN STRUCTURES INC
PO BOX 250
CONCORD, MA 01742

ACRO ENERGY CORP/SUNBURST DIV
10549 STOCKTON BLVD
ELK GROVE, CA 95624

ACUREX SOLAR CORP
485 CLYDE AVE
MOUNTAIN VIEW, CA 94043

ADONIS TECHNOLOGY, INC
1635 SE ENTERPRISE CIR
HILLSBORO, OR 97123

ADVANCE ENERGY TECHNOLOGIES
PO BOX 387
RT 146
CLIFTON PARK, NY 12065

ADVANCED SUN ENERGY
9060 SE GOMEZ
PO BOX 1842
HOBE SOUND, FL 33455

ADVANCO CORP
2250 E IMPERIAL HWY
SUITE 252
EL SEGUNDO, CA 90245

AIRCRAFTSMAN SOLAR INC
WETUMPKA AIRPORT
PO BOX 628
MILLBROOK, AL 36054

AIRLEX INDUSTRIES/
ELECTRA SOLAR ENERGY
440 PARK AVE S
NEW YORK, NY 11016

ALL STATE SOLAR SYSTEMS
2506 DEMARET DR
LAKE HAVASU, AZ 86403

ALTA ENERGY CORP
90 CHURCH ST
PO BOX 342
HOOSICK FALLS, NY 12090

ALTERNATIVE ENERGY RES
1477 LOMALAND BLDG A
EL PASO, TX 79935

AM SOLAR PRODUCTS DIV SQUIRES LABS
1996 S VALLEY DR
LAS CRUCES, CA 88005

AMCOR GROUP LTD
7946 ALABAMA AVE
CANOGA PARK, CA 91304

AMERICAN APPLIANCE MFG CORP
2341 MICHIGAN AVE
SANTA MONICA, CA 90404

AMERICAN HELIO THERMAL CORP
4986 OLIVE ST
COMMERCE CITY, CO 80022

AMERICAN SOLAR HEAT CORP
7 NATIONAL PL
DANBURY, CT 06810

AMERICAN SOLAR KING CORP
700 LOOP 340 S
WACO, TX 76710

AMERICAN SUN SYSTEMS INC
829 FIRST AVE
WEST HAVEN, CT 06516

Only those companies requesting inclusion of their names and addresses are listed in this Appendix.

BEST COPY AVAILABLE

AMSOL
PO BOX 192
ARROYO GRANDE, CA 93420

APOLLO INDUSTRIES INTERNATIONAL
3216 WELLINGTON CT
RALEIGH, NC 27609

APPLIED SOLAR PRODUCTS
4580-A ALMADEN EXPWY
SAN JOSE, CA 95118

APPROTECH
770 CHESTNUT ST
SAN JOSE, CA 95110

ARCHER INDUSTRIES
142 S HALE AVE
ESCONDIDO, CA 92025

ASTRON TECHNOLOGIES INC
5604 DEPARTURE DR
RALEIGH, NC 27604

B&H REFRIGERATION CO
1410 SECOND AVE
YUMA, AZ 85364

BSW SOLAR, INC
1530 BLAINE AVE SE
GRAND RAPIDS, MI 49507

BACK FORTY
MORRILL ST
PO 157
BUCKFIELD, ME 04220

BAY SOLAR INC
2581 LEGHORN ST
MOUNTAIN VIEW, CA 94043

BESICORP GROUP INC
221 CANAL ST
PO BOX 191
ELLENVILLE, NY 12428

BOWDEN INDUSTRIES INC
7540 MEMORIAL PKWY S
HUNTSVILLE, AL 35802

CHAPARRAL SOLAR SYSTEM
3334 W MCDOWELL #20
PHOENIX, AZ 85009

COLE SOLAR SYSTEMS INC
440A EAST SAINT ELMO RD
AUSTIN, TX 78745

COLLECTOR CONSORTIUM
2120 S COLLEGE AVE
EAST WING
FORT COLLINS, CO 80525

COLT INC
1750 COMMERCE WAY
PASO ROBLES, CA 93446

COLUMBIA CHASE CORP
55 HIGH ST
HOLBROOK, MA 02343

CONTEMPORARY SYSTEMS INC
ROUTE 12
WALPOLE, NH 03608

CORNELL ENERGY INC
245 SOUTH PLUMER AVE
TUCSON, AZ 85719

COWAN AND SUN
510 HAMPDEN LN
SALEM, OR 97301

DBA COYNE SOLAR CO
BOX 1120
SAN JUAN PUEBLO, NM 87566

DANCO SOLAR ENTERPRISES
294 BRUBAKER DR
NEW CARLISLE, OH 45344

DELL SOLAR IND INC
1 2ND ST
NEW ROCHELLE, NY 10801

DIVERSIFIED DYNAMICS INC
4500 S SUN-AIR DR
RR 10
MUNCIE, IN 47302

DOC SOLAR HEATING CO
1600 S FARRAGUT
BAY CITY, MI 48706

DUMONT INDUSTRIES
MAIN ST
MONMOUTH, ME 04259

BEST COPY AVAILABLE

ELBART MANUFACTURING CO
127 W MAIN
MILLBURY, MA 01527

ENERGY CONSULTANTS
7710 READING RD STE 203
CINCINNATI, OH 45237

ENERGY CONTROL SYSTEMS
3324 OCTAVIA ST
RALEIGH, NC 27606

ENERGY DESIGN CORP
1756 THOMAS RD
PO BOX 34160
MEMPHIS, TN 38134

ENERGY DESIGNERS
4303 RAWHIDE RD
PUEBLO, CO 81008

ENERGY ENGINEERING INC
4616 MCLEOD RD NE
ALBUQUERQUE, NM 87107

ENERGY HARVESTER
PO BOX 28581
SAN DIEGO, CA 92128

ENERGY MARKETING GROUP INC
7322 EASTERN AVE
GRAND RAPIDS, MI 49508

ENERGY PRODUCTS INTERNATIONAL
404 PIIKOI #114
HONOLULU, HI 96814

ENERGY RESEARCH INC
44315 GRAND RIVER
BOX 707
NOVI, MI 48050

ENERGY TRANSFER SYSTEMS
8505 SUNSTATE ST
TAMPA, FL 33614

ENGINEERS LTD
300 EAST 3RD ST
PO BOX 566
DUBUQUE, IA 52001

ENVIRONMENTAL ENERGIES INC
BOX 98 FRONT ST
COPEMISH, MI 49625

ENVIRONMENTAL ONE CORP
2773 BALLTOWN RD
SCHENECTADY, NY 12309

EQUINOX INC
3350 NW 60TH ST
MIAMI, FL 33142

FAFCO
255 CONSTITUTION AVE
MENLO PARK, CA 94025

FIRST AMERICAN SOLAR CORP
14509 EAST 33RD PL
AURORA, CO 80011

FOUR CORNERS SOLAR
PO BOX 4-8
BLANDING, UT 84511

FREEZE PROOF PRODUCTS
475 CARSWELL AVE
HOLLY HILL, FL 32017

GEM MFG CORPORATION
390 E TIFFIN ST
BASCOM, OH 44809

GENERAL SOLAR CO INC
2650 BRIDGEPORT DR
PO BOX 1258
SIOUX CITY, IA 51111

GENERAL SOLAR TECHNOLOGY INC
10890 QUAIL ROOST DR
MIAMI, FL 33157

GENERAL SOLARGENIC CORP
PO BOX 307
JOHNS ISLAND, SC 29455

GOETTL AIR CONDITIONING
2005 E INDIAN SCHOOL RD
PHOENIX, AZ 85016

GS ENERGY INDUSTRIES
108 JEFFERSON AVENUE
DES MOINES, IA 50314

GULF THERMAL CORP
1645 12TH STREET
SARASOTA, FL 33578

BEST COPY AVAILABLE

HALEAKALA RESOURCES
250 ALA MAHA PL
KAHULUI, HI 96732

HANSON ENERGY PRODUCTS
NEWCASTLE, ME 04553

HELIOCOL USA INC
256 COBLE DR
LONGWOOD, FL 32779

HELIODYNE CORP
700 S 4TH ST
RICHMOND, CA 94804

HELIOTHERM INC
630 PAINTER ST
PO BOX 1844
MEDIA, PA 19063

HI-GRADE PLUMBING INC
98-121 LIPOA PL
AIEA, HI 96701

HIGHLAND SOLAR HEATERS
1120 N SANTA ANITA ST
PO BOX 3174
SOUTH EL MONTE, CA 91733

IMPAC INC
PO BOX 368
KEOKUK, IA 52632

INTERNATIONAL SOLAR TECH INC
RR 2 BOX 340A
DANVILLE, IN 46122

JOHNSTON DEVELOPMENT CO
680 8TH ST SE
ALTOONA, IA 50009

KARRIGER ENGINEERING & MFG
6258 RIVER ST
PO BOX 1000
ALANSON, MI 49770

KTA SOLAR INC
13850 PARK CENTER RD
HERNDON, VA 22071

L&B SOLAR
19770 INDIAN RD
REDFORD, MI 48240

LA-WELA-WAI
RR 1 BOX 517-S
KOLOA, HI 96756

LAKEWOOD LIGHTING SOLAR
13000 ATHENS AVE
LAKEWOOD, OH 44107

LANGLEY PRODUCTS INC
4 PINES BRIDGE RD
BEACON FALLS, CT 06403

LENNOX INDUSTRIES INC
PO BOX 809000
DALLAS, TX 75380

LIVINGSTON SOLAR SYSTEMS
9794 BLACK RD
CENTERVILLE, IN 47330

MAINE SOLAR TECHNICS
360 CENTER ST
BANGOR, ME 04401

MASUN INDUSTRIES INC
1240 FLORIDA AVE UNIT 4
LONGMONT, CO 80501

MESA COUNTY PROPERTY MAINTENANCE
1700 EAST INTERSTATE 70
GRAND JUNCTION, CO 81501

MICHIGAN SOLAR INDUSTRIES INC
8161 EAST SYDNEY
CRYSTAL, MI 48818

MILLER & SUN ENTERPRISES
9450 SW TAGARD ST
TIGARD, OR 97223

MONEGON LTD
7640 STANDESH PL
SUITE 130
ROCKVILLE, MD 20855

MOR-FLO INDUSTRIES INC
18450 SOUTH MILES AVE
CLEVELAND, OH 44128

MORNING STAR
138 INDUSTRIAL LOOP W
ORANGE PARK, FL 32073

BEST COPY AVAILABLE

NATIONAL SOLAR CORP
5627 N 52ND AVE
GLENDALE, AZ 85301

NES INC
PO BOX 398
NEW RICHLAND, MN 56072

NORTH AMERICAN SOLAR
13000 ATHENS AVE
LAKEWOOD, OH 44107

NORTHERN SOLAR POWER CO
311 SOUTH ELM ST
MOORHEAD, MN 56560

NOVAN ENERGY INC
1630 N 63RD ST
BOULDER, CO 80301

ONE DESIGN INC
MOUNTAIN FALLS RTE
WINCHESTER, VA 22601

OPTICAL ENERGY TECHNOLOGIES
472 WESTOVER RD
STAMFORD, CT 06902

PS INDUSTRIES
PO BOX 1576
LAHAINA MAUI, HI 96761

PAOLINO ENERGY PRODUCTS
726 KAIGHNS AVE
CAMDEN, NJ 08103

PASSIVE SOLAR HEATING
3423 S CEDAR
LANSING, MI 48910

PHOTIC CORP
2668 S MEMORIAL HWY
TRAVERSE CITY, MI 49684

PLEIAD INDUSTRIES INC
SPRINGDALE RD
WEST BRANCH, IA 52358

POWER KINETICS INC
7221 S 180TH ST
KENT, WA 98032

PRACTICAL HEATING & SOLAR INC
2430 N PRIOR AVE
ROSEVILLE, MN 55113

PRIME ENERGY PRODUCTS
1223 PEOPLES AVE
TROY, NY 12180

RADCO PRODUCTS INC
2877 INDUSTRIAL PKWY
SANTA MARIA, CA 93454

RAMADA ENERGY SYSTEMS LTD
1421 SOUTH MCCLINTOCK
TEMPE, AZ 85281

RAYPAK INC
31111 AGOURA RD
WESTLAKE VLG, CA 91361

RED BUD INDUSTRIES INC
1600 E MARKET
RED BUD, IL 62278

RESEARCH PRODUCTS CORP
1015 E WASHINGTON AVE
PO BOX 1467
MADISON, WI 53701

RESOURCE TECHNOLOGIES INC
8205 WELLER RD
CINCINNATI, OH 45242

REYNOLDS METALS CO
6601 W BROAD ST
RICHMOND, VA 23261

ROM-AIRE SOLAR CORP
1909 E 28TH ST
LORAIN, OH 44055

S-SYSTEMS INC
BOX 747
RICHARDSON, TX 75080

SAN CASA SUN SYSTEMS
1655 SAN CASA DR
ENGLEWOOD, FL 33533

SEALED AIR CORP
3433 ARDEN RD
HAYWARD, CA 94545

BEST COPY

SERVAMATIC SYSTEMS INC
2610 CROW CANYON RD
SAN RAMON, CA 94583

SOL SYS BY SUN DANCE INC
13995 NW 107TH AVE
HIALEAH GARDENS, FL 33016

SOLAHART
3560B DUNHILL ST
SAN DIEGO, CA 92121

SOLAR ALTERNATIVE INC
71 MAIN ST
BRATTLEBORO, VT 05301

SOLAR AMERICA INC
74 DONALD DR
FAIRFIELD, OH 45014

SOLAR CENTRAL
7213 BRIGNER RD
MECHANICSBURG, OH 43044

SOLAR COMPONENTS CORP
BOX 237
MANCHESTER, NH 03105

SOLAR DEVELOPMENT INC
3630 REESE AVE
RIVIERA BEACH, FL 33404

SOLAR ELECTRIC INC
403 S MAPLE
WEST BRANCH, IA 52329

SOLAR ENERGY ENGINEERING
3925 BARNES RD
SANTA ROSA, CA 95401

SOLAR ENGINEERING CO
345 N 1ST ST #20
PO BOX 97
COCOA BEACH, FL 32931

SOLAR EYE PRODUCTS INC
1300 NW MCNAB RD
FT LAUDERDALE, FL 33309

SOLAR FLARE INC
313 W GOLDEN LN
NEW OXFORD, PA 17350

SOLAR GOLD INC
306 NORTH AMERICAN RD
CHEYENNE, WY 82007

SOLAR HEAT PUMP CO
4264 HYACINTH CIR S
PALM BEACH GARDENS, FL 33410

SOLAR HOMES INC
24 SOUTHWEST AVE
JAMESTOWN, RI 02835

SOLAR INDUSTRIES INC
2300 HIGHWAY 34
MANASQUAN, NJ 08736

SOLAR LIVING INC
PO BOX 12
NETCONG, NJ 07857

SOLAR ONE LTD
777 SEAHAWK CIR
VIRGINIA BEACH, VA 23452

SOLAR ORIENTED
10639 SW 185TH TERR
MIAMI, FL 33157

SOLAR R&D CORP
RT 1 BOX 26
EASTOVER, SC 29044

SOLAR RESEARCH DIV RR INC
PO BOX 869
BRIGHTON, MI 48116

SOLAR RESOURCES INC
S SANTA FE HWY
PO BOX 1848
TAOS, NM 87571

SOLAR SEARCH CORP
RT 49 S BOX 115
CISSNA PARK, IL 60924

SOLAR SHELTER INC
4990 NOME E
DENVER, CO 80239

SOLAR SUPPLIES & BLDG MATERIAL
3213 NORTH PRINCE
CLOVIS, NM 88101

BEST COPY AVAILABLE

SOLAR TECH MFG INC
12150 S ALAMEDA
LYNWOOD, CA 90262

SOLAR TRANSITION INC
320 N MARKET PL
ESCONDIDO, CA 92025

SOLAR TREK INC
3700 SW 7TH ST
OCALA, FL 32674

SOLAR USAGE NOW INC
420 E TIFFIN ST
PO BOX 306
BASCOM, OH 44809

SOLAR WATER HEATERS OF NPR INC
7117 US 19 N
NEW PORT RICHEY, FL 33552

SOLAR WORKS INC
2601 W MAIN
LANSING, MI 48917

SOLAR-EYE PRODUCTS INC
1300 NW MCNAB BLDG G&H
FORT LAUDERDALE, FL 33309

SOLAR-WIND ENERGY DEV CO
BOX 617 JOHNSON RD
WARSAW, KY 41095

SOLARON CORPORATION
1885 W DARTMOUTH AVE
ENGLEWOOD, CO 80110

SOLARTEC INC
250 PENNSYLVANIA AVE
SALEM, OH 44460

SOLARTRAP INC
1720 HURRICANE HARBOR
NAPLES, FL 33940

SOLARY INC
1107 W PINE ST
ORLANDO, FL 32805

SOLCOOR INC
849 S BROADWAY STE 208
LOS ANGELES, CA 90014

SOLECTOR CORP
PO BOX 508
WINDSOR, CT 06095

SOUTHWEST ENER-TECH INC
3030 S VALLEY VIEW BLVD
LAS VEGAS, NV 89102

SOUTHWEST SOLAR INDUSTRIES LTD
2130 SAN MATEO NE
ALBUQUERQUE, NM 87104

STAR PAK SOLAR SYSTEMS
44480 GRAND RIVER AVE
NOVI, MI 48050

STSS CO
477 WOODCREST DR
MECHANICSBURG, PA 17055

SULLY MANUFACTURING CO
SOLAR DIVISION
PO BOX 84
SULLY, IA 50251

SUN AMERICA MFG CO
3732 N 1ST AVE
BIRMINGHAM, AL 35222

SUN BANK INC
305 LAURA ST
WICHITA, KS 67211

SUN DEVIL SOLAR COLLECTOR WORKS
564 E JUANITA AVE UNIT 5
MESA, AZ 85204

SUN EARTH CORP
500 E TIFFIN ST
BASCOM, OH 44809

SUN HARVESTER SOLAR SYSTEMS
PO BOX 867
EDGEWOOD, NM 87015

SUN STANDARD INC
12017 SKYLINE NE
ALBUQUERQUE, NM 87123

SUN STONE COMPANY INC
PO BOX 138
BARABOO, WI 53913

BEST COPY AVAILABLE

SUN SYSTEMS
3831 E BROADWAY RD
PHOENIX, AZ 85040

SUN WATER INC
PO BOX 732
NORTHRIDGE, CA 91328

SUN WISE INC
4000 RIVER DR
GREAT FALLS, MT 59401

SUNDU CO
3319 KEYS LN
ANAHEIM, CA 92804

SUNFLOWER ENERGY WORKS
101 MAIN ST
LEHIGH, KS 67073

SUNHOUSE INC
141 CANAL ST
NASHUA, NH 03060

SUNLAND INDUSTRIES INC
4024 E BROADWAY #1001
PHOENIX, AZ 85040

SUNMASTER CORP
35 W WILLIAM ST
BOX 1077
CORNING, NY 14830

SUNNYCOMB INC
227 SOUTH MAIN
ROCKFORD, MI 49341

SUNNYWATT CORP
RR 2 BOX 63
ENGLISH, IN 47118

SUNSIARAY
10290B DAVISON RD
DAVISON, MI 48423

SUNWIZARD INC
1424 W 259TH ST
HARBOR CITY, CA 90710

SURRY SOLAR SERVICES
249 HICKORY ST
MT AIRY, NC 27030

TENN VALLEY SOLAR
RT 1 BOX 92 JOHNSON RD
CHICKAMAUGA, GA 30707

TERRA-LIGH CORP
54 CHERRY HILL DR
DANVERS, MA 01923

TRISUN CORP
1538 SW INDUST WAY
ALBANY, OR 97321

US SOLAR CORP
COUNTY RD 325
PO DRAWER K
HAMPTON, FL 32044

UNICO MANUFACTURING
1432 PLUM ST
RATON, NM 87740

UNITED STANDARD MANAGEMENT CORP
1735 E INDIAN SCHOOL RD
PHOENIX, AZ 85106

UNIVERSAL SOLAR DEVELOPMENT INC
1701 ACME ST
ORLANDO, FL 32805

UNIVERSAL SOLAR PROD INC
2194 SALEM RD
CONYERS, GA 30208

URJA INC
3401 FORDHAM AVE
SANTA ANNA, CA 92704

VIRGINIA SOLAR COMPONENTS INC
RT 3 HWY 29S
RUSTBURG, VA 24588

WC BROWN AND ASSOCIATES
PO BOX 5134
PORTLAND, OR 97208

WESTERN SOLAR DEVELOPMENT INC
1236 CALLEN ST
VACAVILLE, CA 95688

WESTSIDE CDC
1736 W HIGHLAND AVE
SAN BERNARDINO, CA 92411

BEST COPY AVAILABLE

WHITELINE INC
1501 NW BANK BLDG
ASHEVILLE, NC 28801

YING MANUFACTURING CORP
1245 W 132ND ST
GARDENA, CA 90247

BEST COPY AVAILABLE

BLANK PAGE

Appendix D

Manufacturers of Photovoltaic Modules Responding to the Survey

This portion of a photovoltaic system for generating electricity is a close-up view of

BLANK PAGE

Appendix D

Manufacturers of Photovoltaic Modules Responding to the Survey

ARCO SOLAR
PO BOX 4400
WOODLAND HILLS, CA 91365

CHRONAR
330 BAKERS BASIN RD
TRENTON, NJ 08648

CONCERDYNE CORP
25570 RYE CANYON RD
UNIT G
VALENCIA, CA 91355

ENTECH INC
PO BOX 612246
DFW AIRPORT
DALLAS, TX 75261

FREE ENERGY SYSTEMS INC
PO BOX 3030
LENNI, PA 19052

GLOBAL PV SPECIALISTS INC
22704 VENTURA BLVD
WOODLAND HILLS, CA 91364

INDEPENDENT POWER CO
12340 TYLER FOOTE RD
NEVADA CITY, CA 95959

INTERSOL
11901 W CEDAR AVE
LAKEWOOD, CO 80228

MOBIL TYCO
16 HICKORY DR
WALTHAM, MA 02154

SILICON SENSORS INC
HWY 18 E
DODGEVILLE, WI 53533

SILONEX INC
2150 WARD ST
QUEBEC H4M1T7, CANADA

SOLAR USAGE NOW INC
420 E TIFFIN ST
PO BOX 306
BASCOM, OH 44809

SOLAREX CORP
1334 PICCARD DR
ROCKVILLE, MD 20850

SOLAVOLT INTERNATIONAL
PO BOX 2953 MDA 110
PHOENIX, AZ 85062

SOLEC INTERNATIONAL
12533 CHADRON AVE
HAWTHORNE, CA 90250

SOLENERGY CORP
171 MERRIMAC ST
WOBURN, MA 01801

SPECTROLAB INC
12500 GLADSTONE AVE
SYLMAR, CA 91342

SPIRE CORP
PATRIOTS PARK
BEDFORD MA 01730

SUNWATT CORP
RR 2 BOX 63
ENGLISH, IN 47118

TIDELAND SIGNAL CORP
PO BOX 52430
HOUSTON, TX 77052

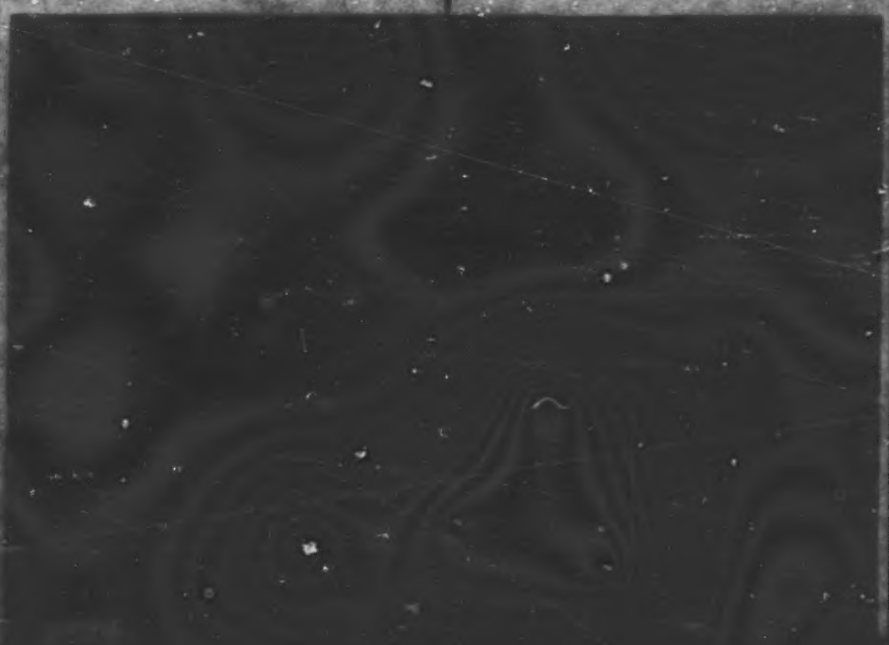
UNITED ENERGY CORP
420 LINCOLN CENTRE DR
FOSTER CITY, CA 94404

Only those companies requesting inclusion of their names and addresses are listed in this Appendix.

BEST COPY AVAILABLE

BLANK PAGE

Glossary



In this system for producing both electrical and thermal energy, solar cells mounted on the underside of the receiver tube are easily reflected in the lower portion of the mirror.

BLANK PAGE

Glossary

Concentrator: A reflective or refractive device that focuses solar rays onto an area smaller than the reflective or refractive surface, resulting in higher intensity solar rays at the point of focus.

Evacuated-Tube Collector: A solar thermal collector in which the collector fluid flows through an absorber tube that is contained inside an evacuated glass cylinder.

Low-Temperature Collector: A collector that generally operates in the temperature range below 110 degrees Fahrenheit. Typically, it has no glazing or insulation and is made of plastic or rubber, although some are made of metal.

Manufacturer: A company that produces and sells either solar thermal collectors or photovoltaic modules, or both.

Medium-Temperature Collector: A collector that generally operates in the temperature range of 140 to 180 degrees Fahrenheit, but may operate at temperatures as low as 110 degrees Fahrenheit. Typically, it has one or two glazings, a metal frame, a metal absorption panel with integral flow channels or attached tubing (liquid collector) or with integral ducting (air collector), and insulation on the sides and back of the panel.

One Sun: Natural solar insolation falling on an object without concentration or diffusion of the solar rays.

Photovoltaic Module: A group of photovoltaic cells. (Cells are solid-state devices that produce electricity when exposed to sunlight.) The electricity is used primarily in applications requiring remote power, such as radio communication, cathodic protection, and navigational aids.

Solar Thermal Collector: A device designed to receive solar radiation and convert it into thermal energy. Normally, a solar thermal collector includes a frame, glazing, and an absorber together with appropriate insulation. The heat collected by the solar thermal collector may be used immediately or stored for later use. Water or water/antifreeze solutions are the most common working media for transferring heat from the collector. Air and special oils which operate at high temperatures are also used in many systems. Pool covers and other devices which do not involve the transport of energy via a working medium are not considered to be solar thermal collectors for the purpose of this survey.

Special Collector: An evacuated tube collector or a concentrating (focusing) collector. Special collectors operate in the temperature range from just above ambient temperature (low concentration for pool heating) to several hundred degrees Fahrenheit (high concentration for air conditioning and specialized industrial processes).

Survey Frame: The list of potential manufacturers of solar collectors or photovoltaic modules to which survey forms are sent.

Thermosyphon System: A solar collector system for water heating in which circulation of the collection fluid through the storage loop is provided solely by the temperature and density difference between the hot and cold fluids.

*U.S. GOVERNMENT PRINTING OFFICE: 1985-461-195:20021

DEPT COPY

BEST COPY AVAILABLE

DOE F 1340.2
(2-80)

Energy Information Administration

GPO SINGLE ISSUE AND ANNUAL ORDER FORM

B

(For use in ordering EIA Publications only – Read Ordering Information Section before completing form.)

SEND ORDER FORM TO: Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402

Enclosed is $ _____ ☐ Check

☐ Money order, or charge to my Deposit Account No.

☐☐☐☐☐☐ – ☐

Order No. _____

VISA

MasterCard

Credit Card Orders Only

Total charges $ _____ Fill in the boxes below

Credit Card No. ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Expiration Date Month/Year ☐☐☐☐ ☐ VISA ☐ Master Card

PLEASE PRINT OR TYPE **NAME AND ADDRESS**

NAME – FIRST, LAST

COMPANY NAME OR ADDITIONAL ADDRESS LINE

STREET ADDRESS

CITY STATE ZIP CODE

(OR COUNTRY)

FOR OFFICE USE ONLY

QUANTITY	CHARGES
ENCLOSED	
TO BE MAILED	
SUBSCRIPTIONS	
POSTAGE	
FOREIGN HANDLING	
MMOB	
OPNR	
UPNS	
DISCOUNT	
REFUND	

PLEASE PRINT OR TYPE THE GPO STOCK NO. OF SINGLE ISSUES OR ANNUALS YOU WISH TO RECEIVE:

_____

_____

_____

_____

_____

_____

_____

_____

GPO 884-888

64